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Contents.

	PAGE
Forthcoming Events	127
Economics Again	127
Little Things That Matter	127
The British Cast Iron Research Association	128
Random Shots	128
Dust in Combustion Gases	129
Foundry Selling Practice	129
Co-operative Research in the Iron and Steel Industry	130
Book Review	132
German Iron Foundry Employers' Federation	132
Automatic Sand Plants	133
Trade Talk	138
Personal	138
Obituary	138
New Companies	138
Iron and Steel Markets	140
Students' Corner	140

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

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The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*).

Forthcoming Events.

SEPTEMBER 6-12.
International Association for Testing Materials:—First International Congress at Zürich.

SEPTEMBER 10-26.
Shipping, Engineering and Machinery Exhibition:—To be held at Olympia, London.

SEPTEMBER 12-27.
International Foundry Exhibition and Congress:—To be held in Milan.

SEPTEMBER 13-18.
Institute of Metals:—Autumn meeting at Zürich.

SEPTEMBER 23-30.
British Association:—Centenary meeting in London.

SEPTEMBER 29-OCTOBER 2.
Iron and Steel Institute:—Autumn meeting at Swansea.

Economics Again.

The national crisis through which we are passing prompts a few comments on some remarks recently made by a distinguished American manufacturer at one of the many conferences which have become so popular in the last few years. These remarks have been given wide publicity and are now supported by one or two English economists. Briefly, he said that it was a mistake to reduce wages, for that would merely reduce purchasing power, and hence create more unemployment, and the whole idea was to create more employment. Our economics may appear old fashioned in the eyes of such modern exponents, but such views appear to us not merely wrong but calculated to interfere with readjustments which are inevitable at the present time.

If such views were pushed to their logical conclusion, the way to cure unemployment would be to double wages all round or cut working hours to one-half. The present world crisis can be traced to one main cause: the belief that we were all much better off rather than worse off after the war, combined with the crazy extent to which nationalism has been pushed since the war, each country endeavouring to be self-sufficing as far as its imports are concerned and yet to have an exportable surplus. Wages, which rose to meet the cost of living, have not been reduced as the cost of living has fallen. Virtually, every cost going into production cost is a labour cost, and, if these are inflated, prices remain high, consumption is diminished, output falls and the whole vicious circle goes on until the world is, industrially, almost at a standstill. Consumption can be revived and, in fact, is being revived by lowered prices, and this must go a great deal further. Increased demand will bring industrial stability, confidence and returning prosperity. But it depends on costs having a relation to world prices.

The present condition is largely a result of the operation of those factors the alteration of which our American friend declares will make it worse. In our view the alteration is bound to be for the better, for regular employment and security is of more importance to the worker than a rate of wages in excess of what is justified by current prices. Everyone desires to see a high standard of living, but the high wages necessary for this can only be justified by high outputs and consequently low prices, which are essential to increased demand. In some quarters the lower-price tendency is being actually handicapped by the conservative buying methods induced during a more comfortable period of high wages. If we cannot get better prices for our goods, the cost of production must come down. There is no alternative, and our orgy of national extravagance must cease.

Little Things That Matter.

It so happens that two foundries which are really busy at the present time are firm believers in the elimination of human fatigue and the use of time studies. Neither of these works is over-mechanised, but steps have been taken to make things "handy." Proper provision is made for the reception of hand-tools so that they can be put down and picked up with a minimum of effort. Then the tools themselves are studied, and their design and weight correlated to both man and job. Improvisation is ruthlessly cut out, and every effort is made to eliminate variables. The last and most expensive variable is in both cases the density of the ramming-up of the various moulds. This is a problem not yet solved, and one necessitating the close co-operation of moulding designers. These people will eventually have to provide their machines with the automatic delivery of an adjustable predetermined quantity of sand to be subjected by the means at their disposal for an exact pressure to be imposed by a definite squeeze-power or number of jars. In this connection we have great sympathy with the manufacturers of moulding machines, who for many years have been in advance of the foundry engineer. They have stated that they could make so many moulds per hour, which has often been disputed by the buyer, because he has failed to provide either facilities for supplying the machine with sand and boxes or provision for getting the moulds away and assembling them. Thus the present position is that quite often the moulding-machine manufacturer has to provide a complete transport scheme in order to sell his machines. He has every right to state publicly his maximum output under ideal conditions, for this is the only true basis of the comparison of one machine with another. Moreover, it gives to the user an incentive to work up to this theoretical production. Maximum production is so often jeopardised by the useless tiring of the individual worker by imposing on him irksome movements of an onerous character. For instance, where flat-ramming has to be done after jarring, the operator should be supplied with a pneumatic rammer, suspended above the job and made to return automatically to this position by means of a counter balance. Again, there should be a handy shelf for carrying the dusting bag, and, if both facing and backing sand have to be shovelled, then provision should be made for doing both jobs consecutively by having a riddle suitably disposed for temporarily taking care of the former. From personal observation of the small matters and a correlation with annual balance-sheets, they are shown to be the most profitable type of study the management of a works can make.

The British Cast Iron Research Association.

VII.—HOW THE ASSOCIATION IS GOVERNED—(*Continued.*)

Research Sub-Committees.

The various branches of the work of the committees are delegated to a series of expert sub-committees, nine in number, on each of which the Chairman of the Research Committee is an *ex-officio* member. Work of interest to various main sections of the trade is covered by:—The Grey Iron Sub-Committee; Nickel and Alloy Cast Iron Sub-Committee; Malleable Cast Iron Sub-Committee; White and Chilled Iron Sub-Committee; Foundry Pig-iron Sub-Committee; and Light Castings Sub-Committee.

Branches of the industry needing specialised study, but of interest to the trade as a whole, are cared for by three sub-committees, as follow:—The Sands and Refractories Sub-Committee; Tests and Specifications Sub-Committee; and Cupola Sub-Committee.

Personnel of Sub-Committees.

There are in addition a special sub-committee on patents and a scientific sub-committee. The personnel of these sub-committees is at present as follows:—

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Mr. J. Arnott, A.I.C. (G. & J. Weir, Limited, Glasgow).
Dr. S. F. Barclay (Mather & Platt, Limited, Manchester).
Professor C. H. Desch, D.Sc., F.R.S. (University, Sheffield).
Mr. H. Field (John Harper & Company, Limited, Willenhall).
Mr. J. T. Goodwin, M.B.E. (Sheepbridge Coal & Iron Company, Limited, Chesterfield).
Mr. J. E. Hurst (Sheepbridge Stokes Centrifugal Castings Company, Limited, Chesterfield).
Mr. W. Jolley (Metropolitan-Vickers Electrical Company, Limited, Manchester).
Mr. E. Millington (London Midland & Scottish Railway Company, Derby).
Mr. John Shaw (Brightside Foundry & Engineering Company, Limited, Sheffield).

Nickel and Alloy Cast Iron Sub-Committee.

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Dr. S. F. Barclay (Mather & Platt, Limited, Manchester).
Mr. F. J. Cook, M.I.Mech.E.
Mr. H. Field (John Harper & Company, Limited, Willenhall).
Mr. W. T. Griffiths, M.Sc. (Mond Nickel Company, Limited, London).
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Mr. G. T. Lunt (Bradley & Foster, Limited, Darlaston).
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Mr. A. J. Betteridge (Brampton Bros., Limited, Birmingham).
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Mr. F. H. Hurren (Coventry Malleable & Aluminium, Limited, Coventry).
Mr. G. T. Lunt (Bradley & Foster, Limited, Darlaston).
Mr. W. B. Parker, F.I.C. (British Thomson-Houston Company, Limited, Rugby).
Mr. H. H. Shepherd (Crane-Bennett, Limited, Ipswich).

White and Chilled Iron Sub-Committee.

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Mr. R. Bulmer (Consett Iron Company, Limited, Consett).
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Mr. R. D. Dick (Pease & Partners, Limited, Middlesbrough).
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Mr. P. Kirk (North Eastern Iron Refining Company, Limited, Stockton-on-Tees).
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Mr. A. Walker (Consett Iron Company, Limited, Consett).
Mr. E. J. Yates, B.Sc. (Goldendale Iron Company, Limited, Tunstall, North Staffs).

Light Castings Sub-Committee.

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Mr. J. Cameron, J.P. (Cameron & Roberton, Limited, Glasgow).
Captain H. J. Kennard, R.N. (Falkirk Iron Company, Limited, Falkirk).
Mr. David Lewis (John Harper & Company, Limited, Willenhall).
Mr. L. P. Mackenzie (Mackenzie & Moncur, Limited, Edinburgh).
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Mr. J. M. Primrose (Grangemouth Iron Company, Falkirk).
Mr. W. Rennie (David King & Sons, Limited, Glasgow).
Mr. A. W. Steven, J.P. (McDowall, Steven & Company, Limited, Falkirk).
Mr. G. A. Ure, J.P. (Smith & Wellstood, Limited, Bonnybridge).

Sands and Refractories Sub-Committee.

Professor P. G. H. Boswell, D.Sc. (Imperial College of Science and Technology, London).
Mr. H. C. Dews (Dewrance & Company, London).

(*Concluded on page* 132.)

Random Shots.

The Truth about the Gayway Foundry.

Although the Gayway Foundry at Eastbourne has achieved a reputation which is international, because of the "hush-hush" policy of its directorate no published description hitherto has been sanctioned. However, Miss Nellie Snookers, the managing directress, has kindly waived this veto in favour of "Marksman," who is now able to disclose to readers of The Foundry Trade Journal the Truth about the Gayway Foundry.

* * *

Much of the Gayway equipment is of a type not to be found elsewhere, and the practice, too, is not common. The preparation of moulding sand, for example, is unique. New sand is brought in small narrow-necked bins by lorry from the sea front (where —— *sub rosa*, this —— the old sand is dumped). A cover of fine wire mesh is fitted to the top of each bin, and a tightly-fitting rubber hood is secured over the mouth of the bin. The sand is then drawn by suction through the mesh cover (thereby being screened), up the rubber hosing attached to the hood, and is discharged into a tank of boiling water, where it is automatically washed. After a washing period of two hours, the sand is removed by miniature dredger and dried on hot iron plates. Having both dried and cooled, the sand is moistened by shower bath, and bullets of plasticine are fired into it by compressed-air pistol to provide the required bond.

* * *

The sand then passes to a sand mill, the mullers of which are hollow and unusually large. The ends of these mullers being detachable, it is possible to introduce small castings and stars into the interiors of the mullers. Thus, the weight necessary to the mullers for the correct milling of sand can be made up by castings and stars, and when the mill is set in motion the mullers by their rotation act as rumblers. The device works perfectly. "Rumble while you mill" is the slogan of Miss Snookers, the Gayway sand expert.

* * *

A similar piece of twin-duty apparatus which Miss Snookers, the foundry manager, has introduced, is a rotary pulverised-fuel-fired furnace. This has been lined with a diamond-hard refractory formulated by Miss Snookers in the Gayway laboratories. The furnace melts high-quality grey iron in the afternoon, and the following morning the castings poured from this iron are placed in the furnace, which, being rotated swiftly, effectively rumbles the castings. The lining is uninjured by this treatment.

* * *

Miss Snookers also has brought out a refractory material for lining cupolas. When mixed, this refractory has the consistency of wet clay. It is moulded around a long and thin steel spindle which, when the necessary thickness of material has been built up about it, is inserted in a vertical position in the centre of the cupola to be lined. The Gayway centrifugal cupola-lining machine is then brought into play. The spindle is made to revolve clockwise at high speed, whilst the cupola shell revolves at the same speed but in the reverse direction. The result is that centrifugal force causes the refractory to be thrown forcibly against the wall of the cupola, where it "stays put" and hardens very much like ordinary cement. The initial cost of these centrifugal linings is, of course, rather expensive, but their life exceeds a thousand melts and patching is eliminated completely.

Marksman.

Dust in Combustion Gases.

By Our Engineering Correspondent.

Some time ago a description appeared in these columns of the new centrifugal dust collectors that have been placed upon the market by Davidson & Company, Limited, Belfast. In this connection, highly interesting are the results they have obtained concerning the extreme state of sub-division of much industrial dust, especially as regards combustion gases. For example, it has always been thought that the dust from chimneys serving mechanical-stoker-fired steam boilers is very coarse, whilst the dust due to pulverised firing is of necessity extremely fine. One of the results, however, of the extensive pioneer work carried out at the firm's research and experimental departments at Belfast is to show there is not very much difference in this respect, as well as to demonstrate the importance of the question of size of the particles.

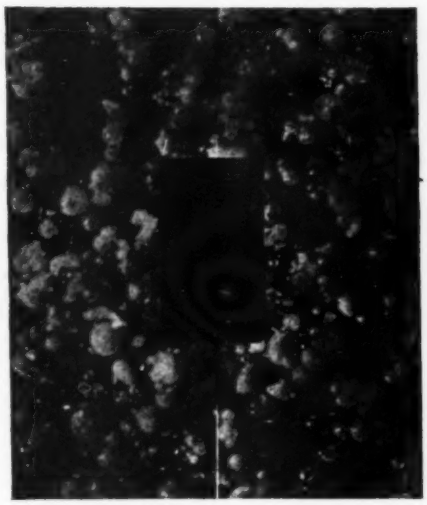


Fig. 1.—Photomicrograph of Dust from Pulverised-Fuel Firing as Separated by the Davidson System. Each of the Lines of the Grid indicates 10 microns, and 1 micron = $\frac{1}{1000}$ mm. Less than 60 microns floats on water.

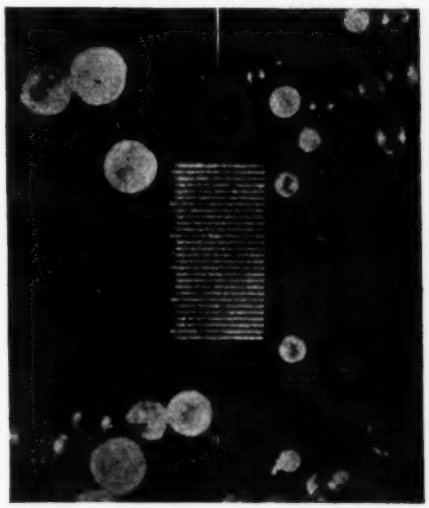


Fig. 2.—Photomicrograph of Dust from Pulverised-Fuel Firing. This shows the portion that floats on water graded into two portions—over and less than 60 microns, an extremely fine state of division.

They have had installed for a number of years past a large-scale test collector, whereby accurate determinations can be made under greatly varying conditions as regards volume, velocity and temperature of air or gas with any type of dust. It is, in fact, largely because of the adoption of such scientific principles that the "Davidson" centrifugal and gravity dust collector has proved such a success, over 500 collectors now being in operation on boiler plants alone, separating 70 to 95 per cent. of the total dust, and more than 400 for general industrial application, including sand-blast cabinets and rumblers.

With regard to the size of mechanical-stoker dusts, most detailed tests with the large-scale experimental collector show, in the first place by the ratio of the weight of dust caught by the collector to the weight of dust gradually fed into the air stream which passes through the collector, an efficiency of 95.5 to 96.4 per cent. recovery. The standard conditions were 18,000 cub. ft. of gas per min. with a dust concentration of 2 grains per cub. ft., and the screen analysis of the separated dust showed only 21.65 per cent. left on a 90-mesh screen (over 0.160 mm. size). Also the dust was so fine that 34.12 per cent. passed through a 200-mesh screen, less than 0.0735 mm. size, and 16.32 per cent. through a 325-mesh screen (less than 0.0432 mm.), while the weight per cub. ft. was 300 grains.

Similar tests were undertaken with dust from pulverised-fired boilers, and in this case the dust used was the finest obtainable from the flues of this class of plant. Under the same conditions of 18,000 cub. ft. of gas per min. a concentration of 2 grains of dust per cub. ft. shows 93.5 per cent. recovery, while higher concentrations show the same general results, especially within the range of 1 to 8 grains of dust per cub. ft.

The dust separated showed 11.29 per cent. left on a 90-mesh screen (over 0.160 mm. size), 50.65 per cent. through a 200-mesh screen (less than 0.0735 mm.) and 30.99 per cent. through a 350-mesh screen (less than 0.0432 mm.), while the weight per cub. ft. was 189 grains.

The result is to prove that the difference as regards fineness between stoker-fired and pulverised-fuel-fired dust is not as wide as is generally supposed. Thus, 77.86 per cent. with stokers and 88.04 per cent. with pulverised fuel goes through a 90-mesh screen, while the respective figures for a 200-mesh screen are 34.12 per cent. and 50.65 per cent., although it will be noted that pulverised-fuel dust is of lower specific gravity. Also, quite 0.01-001 per cent., an appreciable proportion of the dust separated by the collectors, is less than 10 microns (1 micron = one thousandth part of a millimetre), being more in the nature of a "fume" or "smoke."

Highly interesting also, as shown by micro-photographic investigations, is that the fine dust in chimney gases contains a large proportion of white opaque globular bodies and also transparent glass-like particles, both resulting from molten ash, while also present are hollow spherical black globules of unknown origin, with thick cell walls, probably melted coal, particles of coke in various shapes, and to a very limited degree, unburnt coal, as "needles" with sharp edges or as feathery particles.

For drilling manganese steel use a cutting speed of 12 to 14 f.p.m., and the stubbiest drills possible. The drill should be kept cutting whilst in the hole.

Foundry Selling Practice.

By Eric N. Simons.

(*Continued from page* 82.)

No. 7. THE SALES MANAGER AND THE INDUSTRY.

It is not enough in the modern world for a sales manager to devote himself wholly and solely to the mere act of selling or encouraging the selling of his firm's castings. He must rid himself of much sheer routine and detail work, and spare a good deal of thought and attention for the industry as a whole, because the industry, its fortunes and prospects, are vital. Whatever is wrong or going wrong with foundry industries generally will sooner or later hit the particular firm, however well it may be organised. It is far too common in the world of casting production to find men responsible for sales who really do not know at any given moment how their industry stands, whose eyes are focussed on their own turnover sheet to the exclusion of everything else, and who never train themselves to see the writing on the wall before disaster overtakes them.

What is the volume of production in the industry? Is this volume increasing or decreasing? These are important facts. But what is even more important is the maintenance of a sense of perspective in regard to the general outlook. During the entire course of his activities, the sales manager must remember that the collection of statistics is not in itself a goal. A chart that indicates the rise or fall of a particular industry does not alone affect profits. But it is one of the factors that bear upon profits. It indicates a certain broad tendency, and the study of that tendency is of inestimable value in relation to sales forecasting, of which a later section of this series will speak.

Broadly, the economic changes that affect a whole industry can be seen, in embryo, so to speak, before they actually arrive. The sales manager who sees them coming first has a greater margin of time in which to adapt himself and his firm to the new developments. Perhaps an example will best illustrate this. A recent Paper given to the Institute of British Foundrymen gives technical data of value to show that, on the whole, steel valve castings are the best, and that engineers are beginning to realise this. The sales manager with sense and intelligence enough to keep an eye on these authoritative pronouncements sees here a coming tendency. What does he do? If he is a sagacious and energetic man, he makes sure (assuming he is selling steel castings) that all valve users see and read that Paper. He makes sure that his salesmen see and understand it. He supplements the evidence in the journal and the Paper with any he himself possesses. And so, gradually, he directs and stimulates the tendency he sees coming, so that when it ultimately arrives, he is ready and alert to take advantage of it. His spadework is done, and he can begin to reap the reward.

New Developments.

Or, take another example; a steel founder sees growing a tendency to mark roads for the facilitation of traffic and the prevention of accidents. He sees authorities experimenting with white lines and painted letters. He makes stainless steel himself, and thinks immediately: Why not cast the steel into the form of studs that can be driven into the roads? He thus sees a tendency, and by virtue of his foresight he stimulates and guides it into channels advantageous to him.

There are many such tendencies of an economic or scientific character to be observed to-day. The sales manager must study these, watch whether or not they gain headway, and, if so, by what amount and how fast. He must decide how far his firm is running counter to the tendency or otherwise.

(*Continued on page* 131.)

Co-operative Research in the Iron and Steel Industry.

POSITION IN GERMANY AND THE UNITED STATES.

In this Paper on "Co-operative Research in the Iron and Steel Industry," read by Mr. F. N. Speller recently before the American Iron and Steel Institute, various types of research work in the iron and steel industry are defined and classified with particular reference to non-competitive problems that can, by common consent, be worked out through co-operative action to the best advantage of all concerned. The Paper also refers to typical co-operative organisations for handling such problems, both in the United States and in Europe. The term "industrial research," it is pointed out, is now being used to include all kinds of investigations that in any way benefit producing organisations and the consumers of their product. It includes investigations of marketing conditions, distribution, new sales fields, welfare of employees, consumers' problems, as well as the study of fundamental scientific and engineering problems on which the industry is founded. It is possible to spend too much time on problems having to do with lowering costs and increasing production and not enough on developing a wider field of consumption for the product. So marketing and technical research should work in close contact with one another. The present Paper, however, deals particularly with technical research leading to better understanding of materials and processes.

Technical research in many industries has increased considerably in recent years. According to figures recently prepared by the National Research Council, the chemical and allied industries are now leading. Their average annual expense for research amounts to 2.04 per cent. of their capital; the automotive and rubber industries come next, while the American steel industry is reported to be spending an amount equal to 0.04 per cent. of its invested capital for this purpose. The average annual expenditure per plant per year for all industries is given as $50,000. About $10,000,000 per year are spent in the United States on pure science research, and the supply is apparently not nearly equal to the demand. At the same time, $200,000,000 is spent annually on applied research.

Research Work in Germany.

When the Vereinigte Stahlwerke A.-G. was organised in 1926, it may be assumed that their research organisation was based on the best experience available at that time, so the system adopted by this concern is selected as typical of such an organisation. Investigative work in this company centres in several technical committees of experts, a central research laboratory (or "Institut") and a Research Department. The director of the latter department is a member of all committees and is responsible for co-ordinating this work. The Research Department co-operates with the plants in carrying out promptly projects planned and approved by these committees, and correlates the work of the various committees. The more fundamental scientific work is done in the Research Institute.

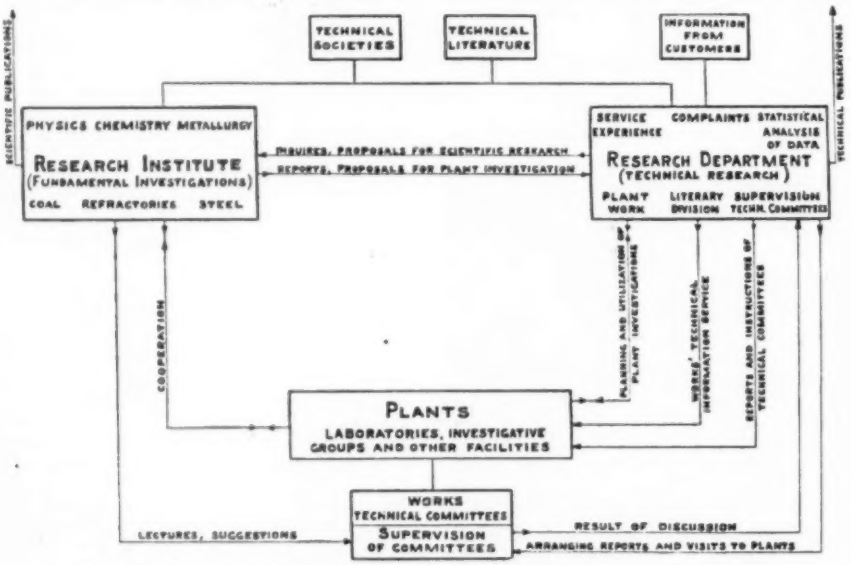
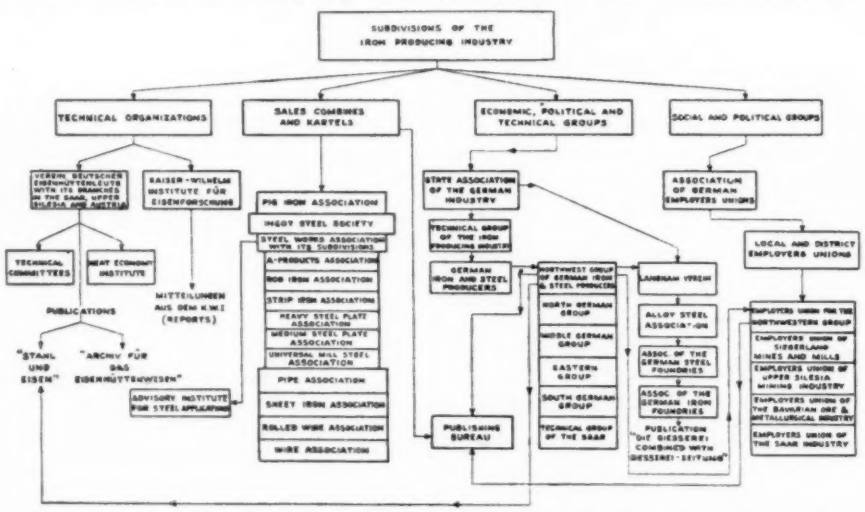


Fig. 1.—Research Organisation of the Vereinigte Stahlwerke A.G.

This research organisation is designed to utilise and stimulate all the latent initiative in the corporation, with a maximum of co-operation from all ranks, from top to bottom, which is so necessary for the success of any research organisation. The scheme of organisation, as shown in Fig. 1, was charted by Drs. Poensgen and Daeves of this company. The tie-in with general co-operative work in the German iron and steel industry is indicated in this chart. The Research Department is responsible for keeping the work of the various committees constantly on the move and also supplies the committee men, and all others in the company who are interested, with abstracts of current technical literature. This department, of course, also co-operates in sales and advertising work. It would seem that the abstracting work might better be delegated to a co-operative association of the industry. It is well known that the Krupp Company has long operated a somewhat similar system.

In Germany, industrial research as a rule is divided into two rather distinct classes, viz., the study of fundamental principles, and the practical application of these to every-day problems. For the solution of the former, the Kaiser Wilhelm Institut für Eisenforschung was established in Düsseldorf in 1918 to undertake the study of fundamental problems relating exclusively to the iron and steel industry. There are in Germany thirty-two examples of this type of institute, each operating under a general director and directing board. The Kaiser Wilhelm Institut in Düsseldorf is financed by the German iron and steel industry through the V.D.E. with the exception of the salary of the director, which is paid by the government. Fundamental and scientific work of interest to the steel industry is also done in several of the technical universities and in other research institutes such as the Materialsprüfungsamt in Berlin. However, most of this type of scientific research on steel is centred in the Kaiser Wilhelm Institut, Düsseldorf, under Dr. Körber.

Applied science research work on everyday problems of common interest to industry that are best handled by co-operative effort are usually acted upon and approved by the committees of the V.D.E. These committees cover the following subjects: ore; coke; blast-furnace practice; blast-furnace by-products; steelworks; machines; rolling mills; plant administration; chemists; materials; heat (fuels and power economics), etc. The committee on heat (supervising committee for fuels and energy economics for iron and steel works) was organised in 1919; its field of work includes assistance to the plants in all questions of heat and energy economics. Any of the above committees may assign work to the research departments of the various companies, to the Kaiser Wilhelm Institut, Düsseldorf, or to some other place where it can be done to best advantage.


SUBDIVISIONS OF THE IRON PRODUCING INDUSTRY
TECHNICAL ORGANIZATIONS
SALES COMBINES AND KARTELS
ECONOMIC, POLITICAL AND TECHNICAL GROUPS
SOCIAL AND POLITICAL GROUPS
VEREIN DEUTSCHER EISENHÜTTENLEUTE WITH ITS BRANCHES IN THE SAAR, UPPER SILESIA AND AUSTRIA
KAISER-WILHELM INSTITUTE FÜR EISENFORSCHUNG
TECHNICAL COMMITTEES
HEAT ECONOMY INSTITUTE
PUBLICATIONS
"STAHL UND EISEN"
"ARCHIV FÜR DAS EISENHÜTTENWESEN"
MITTEILUNGEN AUS DEM K.W.I. (REPORTS)
ADVISORY INSTITUTE FOR STEEL APPLICATIONS
PIG IRON ASSOCIATION
INGOT STEEL SOCIETY
STEEL WORKS ASSOCIATIONS WITH ITS SUBDIVISIONS
A-PRODUCTS ASSOCIATION
ROD IRON ASSOCIATION
STRIP IRON ASSOCIATION
HEAVY STEEL PLATE ASSOCIATION
MEDIUM STEEL PLATE ASSOCIATION
UNIVERSAL MILL STEEL ASSOCIATION
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MIDDLE GERMAN GROUP
EASTERN GROUP
SOUTH GERMAN GROUP
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EMPLOYERS UNION OF THE RAHNLAN ORE & METALLURGICAL INDUSTRY
EMPLOYERS UNION OF THE SAAR INDUSTRY

Fig. 2.—Organisation of the German Iron and Steel Industry.

Figs. 2 and 3, adapted with translation into English of the titles from charts recently prepared and forwarded by the Verein Deutscher Eisenhüttenleute illustrate the relation between various organisations in the German iron and

steel industry, and the structure of their co-operative technical research organisations in detail.

After reviewing the organisation of research in the country, the author proceeds to discuss research work as carried out in the States.

American Industrial Research.

The industrial research associate plans of the Bureau of Standards and the Bureau of Mines are the nearest approach to the foreign systems by which public funds are expended on problems that are in a large part of general benefit to the public; then there are endowed industrial research institutions, such as the Mellon and Battelle Institutes, and the Massachusetts Institute of Technology, that are well equipped for a certain amount of metallurgical work for the use of individual concerns or trade associations desiring to enter into research on any particular problem. The results of work done through these agencies become the property of the sponsor or the public at the option of the former. Such institutions usually take care of the overhead expense so that individual problems may be worked out under these auspices at comparatively small cost to the client. The Mellon Institute of Industrial Research in Pittsburgh is recognised as the pioneer in this system of operation.

Co-operative research of general interest to the iron and steel industry in America is at present sponsored by various institutions including, for example, the following: (1) American Society for Testing Materials; (2) American Society of Mechanical Engineers; (3) American Institute of Mining and Metallurgical Engineers; (4) American Welding Society; (5) United States Bureau of Mines; (6) United States Bureau of Standards; (7) Engineering Foundation; (8) American Institute of Steel Construction; (9) American Society for Steel Treating; (10) American Iron and Steel Institute, and others.

This division of control has advantages and disadvantages. The group that initiates a piece of work usually includes, or can bring together, those most interested, but there is, of course, a lack of general co-ordination, some duplication of effort, and occasionally differences of opinion on minor matters that tend to obscure the main objective. However, each of these groups undoubtedly has special advantages for carrying on certain investigations of advantage to producers and consumers, and it is well known that in many instances very useful work has been carried out under these auspices.

The American Society for Testing Materials has made a notable success of its study of Corrosion of Metals; the Effect of Phosphorus and Sulphur on Steel (in co-operation with the Bureau of Standards and others); their critical abstracts of work done on Fatigue of Metals; and particularly in bringing about co-operative agreement between producers and consumers in the drafting of hundreds of standard specifications for materials of all kinds, often involving a considerable amount of technical research work.

The American Society of Mechanical Engineers has done similar work on the establishment of codes for boilers and other pressure vessels; boiler furnace refractories; heavy-duty bearing metals; and has co-operated with the American Society for Testing Materials and several other societies in the joint study of Effect of Temperature on the Properties of Metals. The Engineering Foundation, in co-operation with the American Institute of Mining and Metallurgical Engineers and the American iron and steel industry, has started to collect and investigate all data relating to alloys of iron. The American Welding Society has done much to develop the art of fusion welding. The Association of American Steel Manufacturers Technical Committees has been reorganised to handle technical subjects in connection with specifications for all kinds of iron and steel products.

The United States Bureau of Standards has made useful contributions on new means of temperature measurement in steel plants, and on the problem of transverse fissures in steel rails. They have also done important work in the study of soil corrosion. The United States Bureau of Mines for nearly five years has provided laboratory facilities, and also men, in co-operation with the Carnegie Institute of Technology and a number of leading metallurgical concerns, for the study of the physical chemistry of steel-making, refractories, abnormality in steel, and other problems of fundamental value, especially to the iron and steel industry.

This work was initiated in 1923, when Dr. Thomas S. Baker, President of the Carnegie Institute of Technology, Pittsburgh, invited representatives of several industries and of the Bureau of Mines to meet together to discuss and carry on co-operative metallurgical research work in Pittsburgh. As a result of this conference an Advisory Board was organised consisting of members of the industry, the Bureau of Mines, and the Carnegie Institute. Each of the three parties represented on the board contributed in cash or in kind toward this work. The board, through its committees, was organised to co-operate with the Bureau of Mines and the Institute in the selection of problems and in the general supervision of this work.

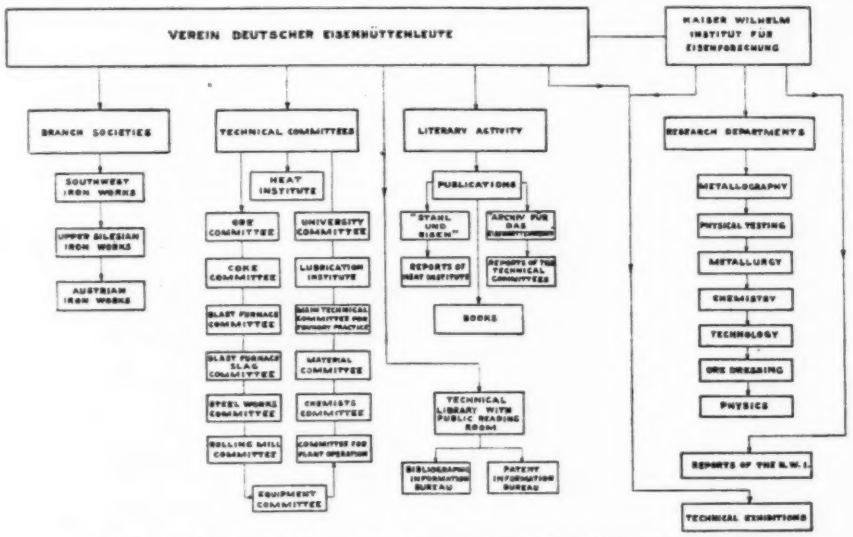

Fig. 3.—Organisation of the Verein Deutscher Eisenhüttenleute.

Foundry Selling Practice.

(*Continued from page* 129.)

But there are even broader tendencies that have to be studied. For example, one may mention those problems that centre on the future of the middleman, the combination of groups of producers under rationalisation schemes, the continual replacement of costly raw materials by synthetic substitutes, of one alloy by another. There are the broad questions of the industry's relation to international trade. All these subjects bear directly or indirectly upon sales actual and potential.

The sales manager must always bear in mind that the foundry industry, and every other industry, with but few exceptions, is always fluctuating between good and bad periods. As a result of better transport, keener and more exclusively national competition, improved standards of living and the desire to retain them, business is now national rather than local, international rather than national. This has rendered selling problems more and more complex and specialised. The old days of easy selling are gone, and probably gone for good. The efficient sales manager, in a large foundry at least, has to know something of economics and of world affairs.

Importance of Economics.

Critics of this emphasis on the broad point of view, as opposed to the purely local, often argue that the sales manager will spend so much time studying the world that he will not have time for his own job. Strictly speaking, there is much truth in this. But the real truth is that this comprehensive study of economic actions and interactions affecting industry should not really be the sales manager's job at all. The only reason for saying here that it is, is that he is the only man in most firms likely to do it, or to realise that it needs doing. Large businesses ought to number among their staff at least one qualified economist, who could act as economic adviser to his board of directors, and study the economic tendencies of all markets as his regular job. Few of modern English firms have any such person in their employ.

Other subjects that should be studied in relation to sales are the position of allied industries. The markets for different products have actually some connection with each other. For example, building operations, when restricted, cause a corresponding restriction of all the industries that produce for the building industry. Timber, bricks, cement, tiles and many other raw materials, all experience a constriction of demand, as do makers of electrical fittings, ironmongers, etc. This, again, brings in furniture makers, pottery firms, stove manufacturers and so forth. Obviously, therefore, the sales manager must keep a watchful eye on the industries to which he sells. A quick perception of shrinking trade in the markets he is primarily interested in will often prove invaluable in preventing excessive stocks or production.

Study of industry generally tends to flatten out the sharp angles of rise and fall in turnover. Accurate forecasting of the trend of events means less over-stocking, and consequently none of that desperate rush to get rid of accumulated stocks at any price that in itself intensifies depression and makes recovery more difficult. It would be quite an arguable thesis that much of the existing depression could have been foreseen, and that if greater foresight had been shown all round, its acuteness would have been considerably lessened. But space does not allow of a development of that thesis. The sales manager who reads these lines can take it home and think about it for himself.

(*To be continued.*)

Chromium-plated work which has to be highly polished should be polished before plating and then buffed at a speed of 14,000 f.p.m.

Book Review.

Handbuch der Eisen- und Stahlgiesserei, Vol. IV (Iron and Steel Foundry Handbook). Edited by Dr. Ing. C. Geiger. 2nd edition. Published by the Verlagsbuchhandlung Julius Springer, 23-24, Linkstrasse, Berlin, W.9. Price 72 rm.

The volume is devoted in a general way to the commercial organisation and management of foundries, the construction of foundry buildings and plant, the metallurgical advances made in grey iron and the management of men. The first section—a matter of 79 pages—is devoted to costing, and the thought which has been devoted to this question in Germany is well illustrated by the fact that no less than 13 text-books have been written on the subject, whilst references to articles in the technical Press number nearly 60. The only reference to an English authority—Mr. A. W. G. Bagshawe—is marred by a failure to distinguish The Foundry Trade Journal from our American contemporary.

The second chapter is devoted to piecework and time studies in the iron and steel foundry. We doubt very much whether the extremely interesting information presented is obtainable elsewhere in any language. Some British foundries, like Qualcast and the Midland Electric Company, have done much valuable work, some of which has been published, but the whole question is analogous to a drug. It is a dangerous plaything, and is best left in the hands of a specialist. Those inclined to experiment must tread exceedingly warily.

Section III treats of rationalisation in the foundry. It must not be imagined that this is merely a dissertation on large quantity-production foundries, because, actually, it is designed to show to the jobbing founder the possibilities of his trade by the introspective method of re-examining everything he uses, does and controls, to ascertain whether some improvement could not be made at virtually no cost at all. Amongst other items attacked are ridiculously heavy, ill-formed double-ended rammers, walls used as wardrobes, hose-pipes lying across pathways, handiness of tools when coremaking or moulding—in general, the very things which should be eliminated during an intelligently-conducted spring cleaning.

The use of conveyors in moulding practice is covered in Section IV, the very first lay-out shown being strongly reminiscent of the Cardiff Foundry Company's, except that the moulding machines are between the longer sides of the conveyor instead of outside, whilst the metal is carried on a mono-rail instead of being shanked. There is a number of other lay-outs described and illustrated, including an interesting bath-tub lay-out by Badische.

Section V carries the subject to standardisation, in which all the work of the D.I.N. (the German equivalent of the B.E.S.A.) is passed in review, in so far as it affects foundry practice, whilst the specifications germane to the work of the non-ferrous, steel and iron—including malleable—trades are reproduced. Many auxiliary matters, such as the composition and consumption of monolithic cupola linings, moulding-box pins, pattern colours, use of graphite crucibles, sieves and runners, risers and ingates, are dealt with.

Accident prevention in the foundry forms the subject-matter of Chapter VI, and in this connection it is interesting to note that the horizontal barrel-shaped ladle, scarcely ever used in Great Britain and cupola-tapping devices—also a *rara avis* in this country—are recommended. A very sensible gadget shown on page 221 is a jib carrying a compressed-air line operating a water-spray. Primarily, the pipes are kept off the ground, and, secondly, the sand is damped quite evenly, thus preventing real wet spots. In the bibliography to this section only one British reference is given, and, although it is an excellent Paper, we still regard Mr. A. R. Bartlett's contribution as being the best so far printed.

Section VII is devoted to the lay-out and classification of foundries, and included is a very interesting table (LXVII) due to Cole-Estep, which gives the output in tons per sq. ft. for various types of foundries. In fact, the relative space to be occupied by the various departments is given a considerable amount of thought and space. Many interesting lay-outs for cupolas, core making and drying, cleaning and storing, and patternmaking, are shown.

The storage of raw materials is very interestingly dealt with, and the sketch (Fig. 126) of a scrap-breaking plant by means of a ball lifted by a magnet shows a well-arranged lay-out.

The completeness of this work will be appreciated when even such details as the foreman's office and ladle preparation have not been forgotten. Other subjects dealt with are school and floating foundries for duty with the navy. Its extent will be gauged when we state that there are many dozens of plans and photographs of existing foundries taken from all over the world. Even for steel foundries over 30 illustrations, mainly lay-outs, are reproduced.

Important sections are devoted to malleable foundries, radiator and pipe foundries, including spun pipes. The heating, lighting and ventilating of foundries is the final subject studied in Section VII.

Section VIII opens up with some recent developments in high-duty cast iron, wherein diagrammatically is set out the influence of all the usual elements. The metallurgy of growth and malleablising, and kindred questions, are excellently dealt with. Chapter IX covers the subject of sands and sand-testing, and Chapter X the human element in foundry practice. This latter is largely taken up with the question of recruitment of apprentices, their training—professional, physical and moral—whilst lengthy studies such as vocational suitability, fatigue, physical adaptability, development of skill in craftsmanship, are presented with copious illustrations.

It should be realised that the Germans have given a great amount of thought to these subjects, and whilst we personally attach but little importance to them, we confess that they are apparently successful with German mentality but equally a failure with the French. In a pocket at the back are five large-scale lay-outs of well-known foundries. The extensive reproduction of such matter, which is characteristic of the book, makes it thoroughly acceptable to those like the reviewer who confesses to only a moderate knowledge of the German language. This volume is an excellent treatise which should be bought by everyone who can read a few words of German and is interested as an executive officer in the foundry industry. The book contains 618 pages, is illustrated with 526 pictures and diagrams, and is splendidly indexed and bound.

V. C. F.

German Iron Foundry Employers' Federation.

The 61st annual general meeting of the Verein Deutscher Eisengiessereien (German Iron Foundry Employers' Federation) will be held on September 3 and 4 at the Ingenieurhaus 27, Friedrich-Ebert Strasse, Berlin. The new President, Baron von Wittgenstein, will preside, and the following technical Papers are to be presented at 4 p.m. on the first day:—

(1) "Transport Problems in the Iron Foundry," by Dipl. Ing. Blotenberg;

(2) "Metallurgical Advances in the Knowledge of Cupola Practice," by Dr. Ing. Osann, jun., and

(3) "A New High-Strength Pig-Iron for Foundry Use," by Prof. Dr. Ing. Piwowarsky.

On the second day, a lecture of an economic character is to be given by Prof. Dr. E. Schmalenbach, on necessary measures for the consolidation of the structure of capital. As usual, there will be sessions devoted to the study of the raw materials markets and the presentation of the directors' report.

The British Cast Iron Research Association.

(*Concluded from page* 128.)

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Hard scale in a boiler can be softened by boiling in it for 50 hrs., by means of a slow fire in the furnace with the manhole cover off, water to which some soda ash and a small amount of caustic soda has been added.

Automatic Sand Plants.*

By E. V. Ronceray, Vice-President, Association Technique de Fonderie.

The necessity of reducing prices of foundry products has led recently to the designing of continuous plants in order to save labour and give better products. The installation of a continuous-casting plant is practical when a sufficient quantity of castings of a uniform alloy is required. The choice of the melting units is commended by the possibility of the melting plant to give at reasonably short intervals metal of suitable composition. The moulding must be timed in such a way so as to bring, when necessary, moulds ready for pouring, in sufficient quantity to the pouring station. As a consequence, the sand has to be prepared and transported in proper conditions and arrive at the proper time to permit the performance of these operations. It is the part of the problem referring to the sand with which it is proposed to deal.

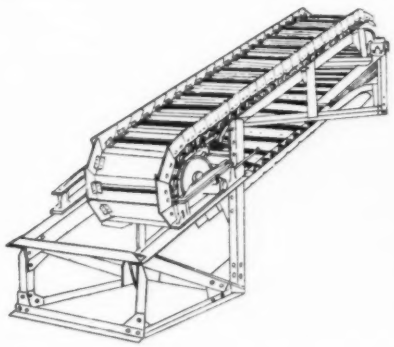

Fig. 1.—Steel Pan Conveyor for Transporting Sand from the Shake-Out.

Starting at the shaking-out grid, the sand falls down in a hopper in a hot condition, which means that it is not possible to transport it from this point except by use of a heat-resisting material. The best apparatus is a steel pan conveyor, such as is shown in Fig. 1. On account of the high cost of such a conveyor and its aptitude to wear out, care is taken to make it as short as possible, to reduce its speed and to make it substantial enough so that it can be kept in good condition for a reasonable time, in spite of the hard work it has to perform. The new sand is added, either before the shaking-out grid on the moulds, or after the shaking-out grid; sometimes the new sand is added later on, but it is preferable to add it as soon as possible. It can be added, either by hand or mechanically, after the shake-out grid and before the next transporting apparatus so that it has a chance to be roughly mixed during the next operations.

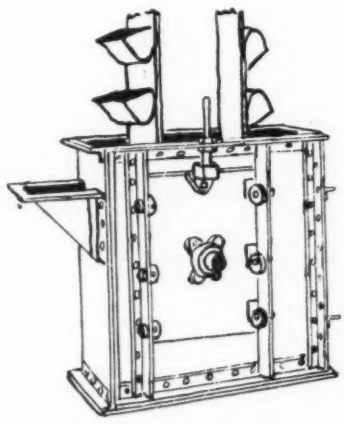

Fig. 2.—Belts having Buckets Attached are Suggested for Elevating Sand.

The sand has next to be cleaned, transported or elevated. If the foundry is handling ferrous products, a magnetic drum is certainly a great help to separate nails, clippings, gaggers, etc., from sand. This magnetic device is better placed as soon as possible after the shake-out grid, so as to avoid an accident which could happen from introduction of some metallic piece as a gagger, or a runner or gate into the sand-transporting apparatus.

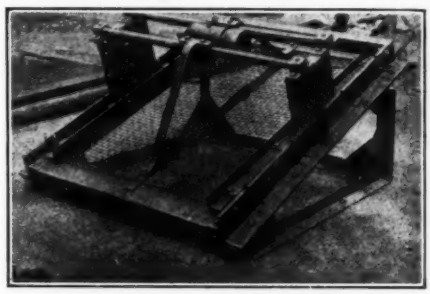

Fig. 3.—Vibratory Screen for Ridding Sand of Extraneous Matter.

Sand Elevators.

The sand elevators can be of several types. Practice has shown that chain elevators should be dispensed with in sand transporting, as they wear out quickly on account of the abrasive nature of sand as a material. Experience has led to the use, preferably, of india-rubber belts, on which are bolted pressed steel or malleable buckets, as shown in Fig. 2. These belts run on pulleys, the top one being driven and the bottom one being fitted with a tensioning device. The top pulley is generally driven by means of an electric motor through a reduction gear, and the general approved construction is to fit the bottom pulley in bearings fixed on to movable lateral plates of ample dimensions, so that it is possible to withdraw the pulley and shaft through the opening of the case corresponding to the plates, if, and where, necessary.

Such belts generally work at the speed of 3 ft. per sec., and the buckets are fixed at 12 in. distance. The sizes are selected so as to be able to obtain approximately the output required, with buckets no more than three-quarters full. Even under these conditions, there is always some sand falling down from the top of the apparatus, and it is wise to have an inclined plate fixed between the two sides of the belts so as to take away such sand from the elevator casing. The elevator boot must be frequently cleaned, in spite of these precautions.

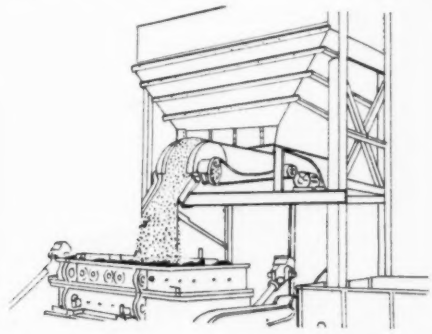

Fig. 5.—Showing the Means Adopted for taking Sand from Storage by an Apron Plate Conveyor.

It must be remembered that an elevator does not work properly if it is not regularly fed. It cannot scoop out sand from a heap; the buckets would make their way through the sand and eventually feeding would entirely stop. This is due to the consistency of sand, which does not fall down as grain or as any dry material. Elevators may be made vertical or inclined. When they are made vertical they do not require guides. Such guides are absolutely necessary when they are inclined. This is probably why almost all sand elevators are made vertical.

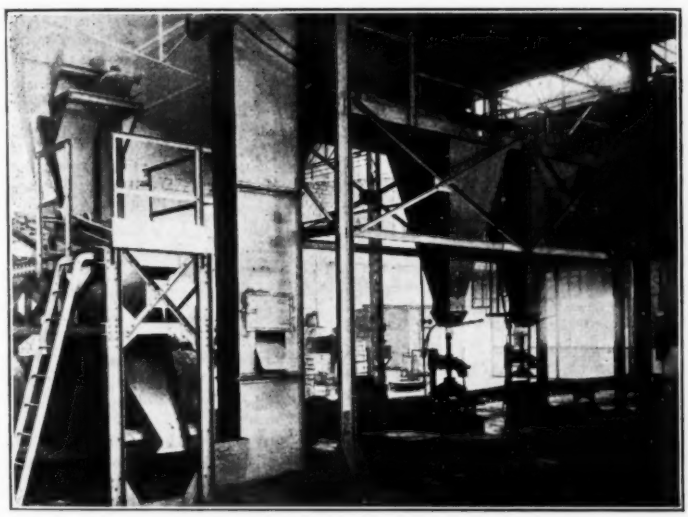

Fig. 4.—General Appearance of a Small Mechanised Foundry.

The separation of sand from core prints, pieces of wood, rags, nails, etc., is simply made by some sort of sifter, either polygonal or circular. The rotary sifter has been used to a great extent in the past. Recently, vibratory screens of various designs seem to have been preferred, a typical one being shown in Fig. 3. They are more

* Paper presented before the Lancashire Branch of the Institute of British Foundrymen.

effective because, on account of vibrations, sand does not stick so much as is the case with the rotary screen. Further, when necessary, it is possible to superpose two or three different sizes of screens, and, consequently, to have separations of different sizes of materials. Moreover, the space occupied is smaller. Nevertheless, in a continuous plant, it is usual to have only one size of mesh. The vibration to the screen can be effected by a variety of methods, one of the simplest being to have a belt-driven rotary arrangement out of balance, running at, say, 1,200 revolutions per minute, vibrations being transmitted to the screen by merely two rods.

Preparing the Sand.

From the screen the sand may be sent either to the sand-mixing machinery or to the sand

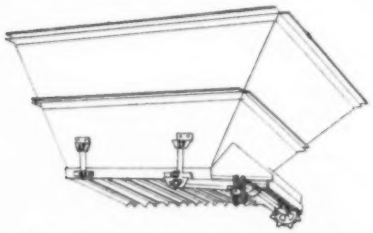

Fig. 6.—Sand-Slicing Apparatus.

bins. Here one has to consider the question of the amount of sand in use throughout the system.

For some propositions a minimum amount of sand must be chosen and used as many times as possible during one day's work, and arrangements made to cool the sand by suitable devices. In the opinion of the author, it is better to have a sufficient amount of sand, so as to prevent it from getting strongly heated. It would appear

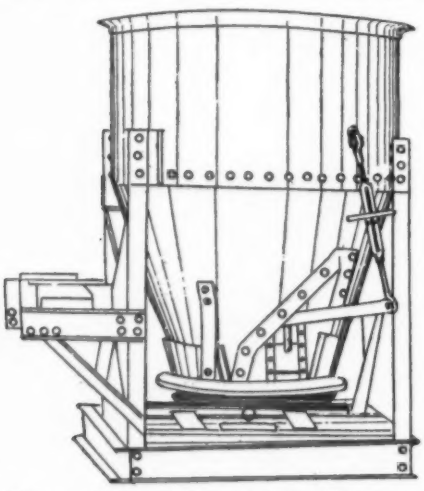

Fig. 7.—Circular Type of Sand Bin showing Method of Extraction.

rational to arrange the plant that the sand is used two or three times a day.

This means that sand storage of sufficient capacity must be provided. The question to be considered at this point is to determine whether the sand bins are to be filled with completely-prepared sand or with unconditioned sand. Good reasons can be found for both points of view. Storing of conditioned sand is preferred by some people because should a stoppage, voluntary or accidental, of one or two hours occur in the conditioning plant, this would not stop the entire plant. Personally, the author prefers to store the bulk of sand in an unconditioned state, because prepared sand in a large bin does not keep in good condition for use. Moreover, it must be remembered that conditioning apparatus now on the market is sufficiently reliable to permit of the preparing of sand just a short time before actual use.

Removal of Sand from Storage Bins.

The extracting of sand from large sand-storage bins can be done in various ways. In no case is it possible to get sand out of such a bin by simply opening an aperture. The pan or metallic apron conveyor, as described above, can be used. It consists of a succession of plates attached laterally to the links of two chains, engaged on sprocket wheels. The sand bin is made with a rectangular opening at the bottom, under which the apron plate conveyor revolves and also covers the opening. The front of sand bin is closed by an adjustable plate, thus regulating the amount of sand which is taken by the apron plate conveyor, as shown in Fig. 5. This is one of the safest ways to take sand from a large bin. The steel pan conveyor can sometimes be replaced by a simple india-rubber belt supported on rollers, and some people also prefer to use a slicing apparatus between the sand bin and the india-rubber belt.

Points on Sand Delivery.

The sand-slicing apparatus is composed of a succession of flat bars with a certain distance between all of them. These bars are under the rectangular opening of sand bin, and whilst the bars are stationary the sand does not fall on the belt. But when the bars, which are connected together, are moved backwards and forwards the sand is sliced off, and as it comes down a certain amount is projected on to the belt, and sand falls down again inside the bin to replace the sand which has been cut away or sliced. The sliced sand falls down on the rubber belt as above. The space between bars and the amplitude and speed of motion of them regulate the amount of sand sliced. Provision is made for altering the amount of displacement, and consequently this agrees with the amount of sand to be extracted from the sand bin.

When the sand bin is circular, as in Fig. 7, the extraction of sand can be obtained through a rotating circular plate, which closes the bottom of the bin. The sand falls on to the plate, and a fixed plough extracts it from the surface of the plate. Further sand falls down to replace it, and is extracted at the next revolution. Sometimes the sand bin is fixed, sometimes it revolves with the plate. However, whatever the extracting apparatus of the sand from a sand-storage bin, it must be fed regularly to the conditioning apparatus. These are of various and different types, and it may be stated here that many of the American plants are fitted with apparatus of a very rough nature.

Reconditioning Sand.

The two machines usually used in U.S.A. for this purpose are the revivifier and the one row of rods type conditioning apparatus. The revivifier is composed of a number of blades fixed on a shaft on to which the sand falls, as illustrated in Fig. 8. The sand is projected by these blades against a row of suspended bars or chains, which break the flow of sand, and from there it falls down into a hopper, from which it is taken away. The whole machine is enclosed in a steel casing. As the sand is liable to stick, the casing is pivoted on one end and a cam mounted on a shaft is provided on the other end, so as to lift it around the pivot at each revolution and let it fall down against a stop, so that the shock so obtained detaches the sand from the casing.

The other conditioning apparatus is very similar to the well-known sand-disintegrating machine, as it is known in Europe. As shown in Fig. 9, it is generally composed of four rows of bars running in opposite direction, and consequently is liable to break should a piece of metal enter the machine. In the American machine, therefore, three of these rows are dispensed with, and only one, which is made very strong, is retained, with the result that there is

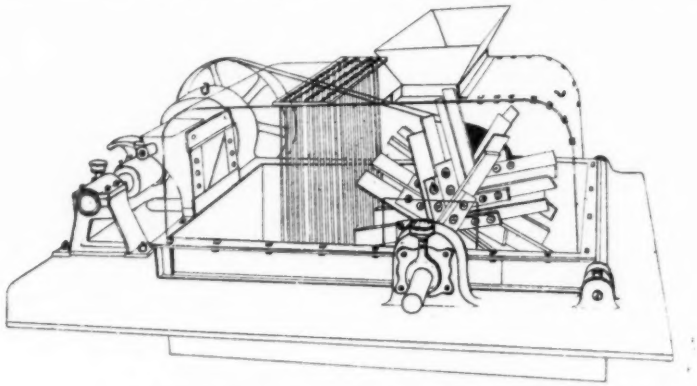

Fig. 8.—American Type of Sand Revivifier.

less chance of the machine being broken, but the sand cannot be said to be seriously treated or worked.

Milling the Sand.

Recently some attempts have been made to improve the treating or conditioning of sand.

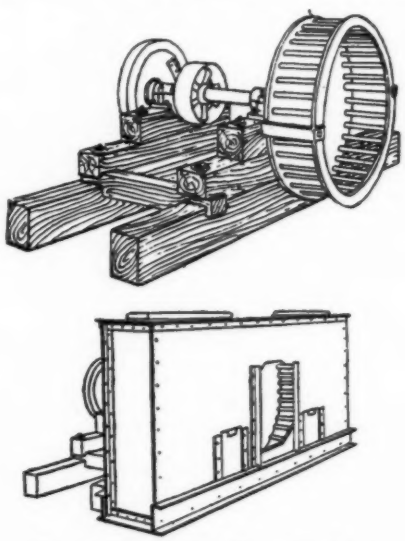

Fig. 9.—European Type of Sand Disintegrator.

For instance, pug mills have been used which are composed of two shafts, with blades fixed in a helical manner round them. The sand is fed in at one end and, owing to the action of the blades, is moved slowly through to the other end. This is a little better than previously described machines, but still far from being

satisfactory. There is no doubt that a thorough rubbing of the sand is the only way to cover the silica grains of sand with the added clay. That clay can be either as pure clay or clay from a strong new sand, and to obtain a proper rubbing and incorporation, the clay must be in a wet condition. Machines have long been known to do this work, but their output was very small, and none of them was continuous. The machine commending itself, and which is the result of well over ten years' experimenting with different types of sand mills, is based on the fact mentioned above. A very simple experiment can show the importance and effectiveness of rubbing. This experiment, which the author made before some American foundrymen in 1907, was the following:—Taking a certain amount of silica sand on the one side and of strong moulding sand on the other side, if one mixes, say, half and half of these sands together, practically

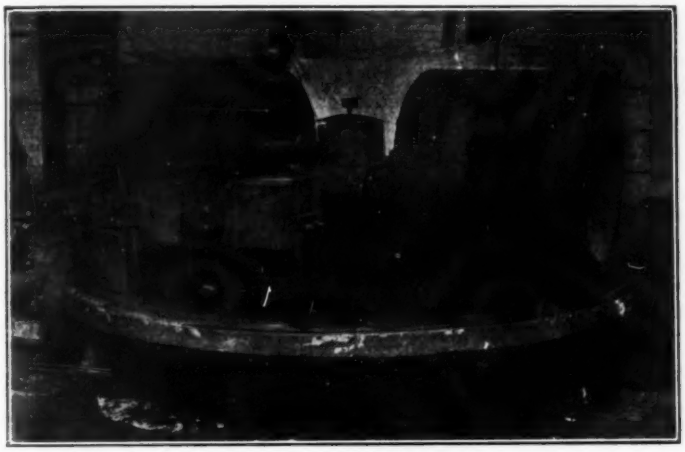

Fig. 10.—A Sand-Rubbing Type of Mill.

no bond is given to the mixture; but if one uses a roller, as is common in French art foundries, and rubs the mixture for one minute, then two minutes, then three minutes, and so on, the samples taken at each step of the experiment will show that the bond and cohesion augment up to a maximum, after which the rubbing action has no more effect.

The sand finally obtained shows the greatest possible bond and permeability, and the grains are not destroyed. The clay is evenly distributed around the sand grains; this same rubbing

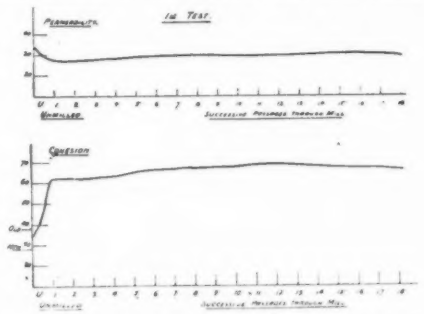

Fig. 11.—Showing the Rapid Development of Cohesion when Suitable Milling is Carried Out.

action can be obtained by a similar action of rubbing with the shoes, and this result is very desirable in actual practice. The incorporation of wet clay is very difficult when a large quantity of sand is required, and this is the reason why attempts have been made to incorporate new sand after it has been dried and pulverised. Various machines have been used for that purpose. It is a most expensive process, and at the same time considerably reduces the permeability of the final product. This method is specially used in any country where the sand is of a rocky nature or of very high clay-content, and also where a fine skin is considered as of primary importance. A good part of the natural bonding qualities of clay are destroyed by that process, and there is no doubt that the development of a sand machine capable of incorporating, by a wet process, clay matter to burnt or silica sand is of the utmost importance.

This has, however, been successfully accomplished by the author through the use of abnormally wide mullers of a separately-determined weight, as shown in Fig. 10. Two or more mullers are used, and between each of them a correctly-designed set of cutters is cutting up the cakes produced by the mullers before the passage under the next muller. The driving arrangements previously provided remain approximately the same, that is to say, the now well-known flat circular plate driven through bevel gear and pinion, with feeding at the centre of the plate and discharging at the outside, but the patented arrangements previously described have entirely changed the method of working and the output of the machine, and the resultant sand.

Experiments have been made during the last year with the following result: The output of a machine with an 8-ft. dia. plate easily attains 15 tons per hr.; further, the sand is not crushed, and the bond and permeability are exactly the same after one passage in the machine as after eighteen passages, as shown by the curves (Figs. 11 and 12), the rubbing action being completed at its maximum after one single passage in the machine, and further, there is no disintegration of sand grains after numerous passages (Fig 13). Further experiments have been made for various outputs, say 5 and 10 tons per hr; the result is exactly the same.

It is interesting to note that the action of the machine is very peculiar. On account of the construction of the machine, a very great difference of speed exists between the mullers and the flat circular plates. There is a point of the plate where these speeds are practically the same, but near the centre of the plate the speed of the muller is greater than the speed of the plate, while it is the reverse at the outside edge of the plate. The result is that the rubbing action is very intense near the centre. Cakes are formed, and if different-coloured old and new sands are used, it is very easy to see the new sand mixed with the old one in long laminated strips which, after some time, are becoming thinner and thinner and also shorter, showing that the rubbing action is getting more and more perfect in approaching the centre of the muller. After this point the speed of the plate is greater than the speed of the muller. The speed of the plate at the outside edge is 240 ft., at the internal side 80 ft., and the speed of the muller is between the two, *i.e.*, 120 ft. per min., with some variations at different loads.

At the outside edge the mixture is perfect, the clay is well incorporated, but on account of the great difference in speed and the arrangements of machine, the cakes no longer exist; the sand is quite fluffy, velvety in texture and feel, so that in recent plants the disintegrator, normally used after the machine, has been eliminated.

No complicated device is necessary to make the sand travel from the centre to the periphery.

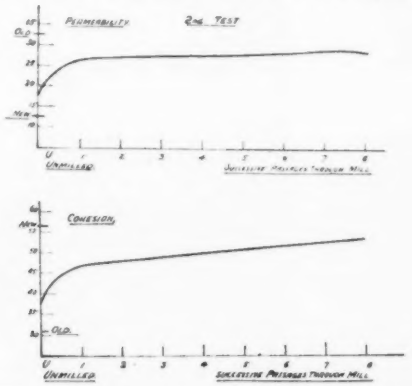

Fig. 12.—As Fig. 11, but using a Different Sand Mixture.

This motion is obtained from the natural action of the machine; only two scrapers are used, one at the centre, to direct the sand under the inside edge of muller, and another at the rim, to direct the finished sand into a bucket or transporting device. The action of the machine is continuous; it is only necessary to feed the sand, either by hand or, better still, by mechanical means, at the centre of the machine, and it is evacuated automatically in a perfect condition at the exit point.

Of course, the mullers are arranged so that they can ride up and down according to the

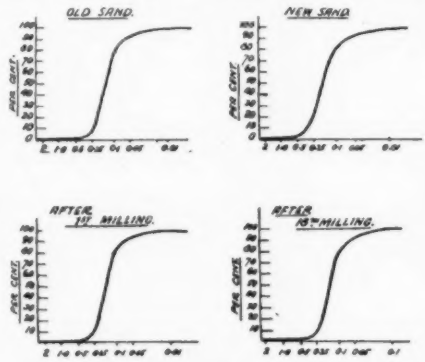

Fig. 13.—Showing Absence of Grain-Size Diminution after Repeated Millings.

thickness (*i.e.*, the output) of the sand, and means can be provided to prevent the mullers coming in contact with the plate, but, owing to the continuous action of the machine, such steps have been found unnecessary. Any grinding action of the mullers only takes place when there is a very small thickness of sand under them. The large width of the mullers militates against the crushing of grains, so whilst the first machines were made with stops—and they could still be provided if required—it may be considered that they are useless except in special cases, and especially in continuous plants. A machine of this type, capable of giving an output of only 5 tons an hour, has been designed for small and medium-size foundries.

Conveying Conditioned Sand to the Machines.

After conditioning, the sand has to be transported to the various machines. Several devices are used for this purpose. The simplest and cheapest of all devices is a belt (Fig. 14) which can be of cotton or other fabric, india-rubber or steel. Moist sand can be transported easily by these various devices without the slightest difficulty, even without the use of deflecting rollers. When sand has to be transported from one point to another without having to deliver *en route* no better device can be selected. But when sand has to be delivered in a succession of bins, the question is entirely different. To direct the sand from the belt to the bins necessitates the use of ploughs. By the action of these ploughs, sand is deflected in a large mass; it then falls down in the bins. Not only is the action of these ploughs deleterious to correctly-prepared sand, but the falling down of such amounts of sand through several feet to the bottom of the sand bin, has the result of sand-packing, somewhat similar to the action of a sand-slinger using the sand bin as a moulding box, after which the extraction of sand becomes very difficult. Further, sand can pass above the bin for a long time while the bin is practically empty, and be uselessly transported all along the line, thus necessitating other means to return the sand to the starting point.

In other cases, several men may require sand, but the first one on the line is taking it all and the last one may wait some time before being served; thus, the usual practice is to have a man stationed alongside the belt over the bins to inspect the sand bins and see that they are filled in proper time, helping the sand to fall down when it sticks in the bins. A much better method is the use of a flight- or push-plate conveyor (Fig. 15), which consists of a succession of vertical plates pushing the sand in front of them. These plates are fixed to two lines of chains on the side of a trough laid above the individual sand bins.

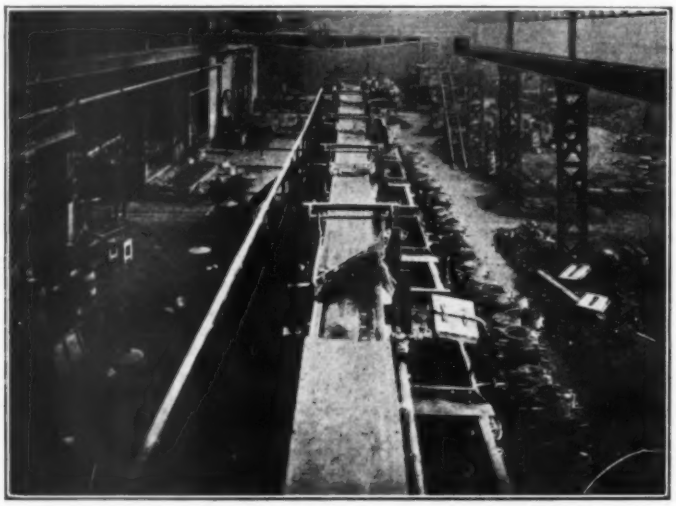

Fig. 14.—Belt Conveyor for Transporting Prepared Sand.

The openings are provided in this trough so that sand can fall down as soon as a small void has taken place in the bins; the sand thus does not fall from a high point and consequently is not rammed hard in the sand bin, in the same manner as with the belt and plough type (Fig. 14). The openings to the bins are distributed at various places on the width of the trough, so that sand is taken at various points of it. It is easy to understand that two or three openings are enough, as after a few feet, the sand is redistributed equally on the width of the trough.

Fig. 15.—Push-Plate Conveyor for Feeding Sand Bins.

Other devices can also be used for transporting the sand, but those described above are the most popular.

Hopper Delivery.

Referring to different types of sand hoppers, two or three processes are used for taking sand from them. For small moulds, the clam shell, shown in Fig. 16, is considered the best. The action is such that the opening eases the sand and facilitates its falling down, but its closing is rather more difficult than other devices. A good precaution is to design the opening device so that the man has to lift for opening and pull for closing, his weight facilitating the action. By this device, small amounts of sand can be taken from the hoppers easily, and this type is very convenient for small boxes.

Fig. 16.—Hopper Device for Feeding Moulding Boxes.

The oscillant undercut gate type (Fig. 17) is more convenient for larger boxes, as the sand does not fall down with its use until the opening is at least of six inches. By this time a bulk of sand—not easy to regulate—is leaving the hopper. However, the closing is very easy. When boxes are very large, a pan or belt conveyor under the sand bin started with a push button is very convenient. This arrangement is shown in Fig. 18. Two or three other devices can be used, but those described are the most popular.

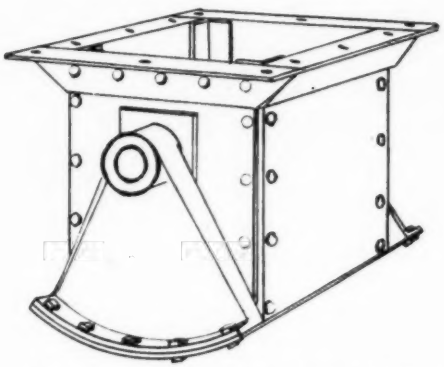

Fig. 17.—A Device for Feeding Large Moulding Boxes.

Conveying Spilt Sand.

Sometimes spilt-sand devices are used. They have to be underground and belts are not recommended for this purpose, as sand is always sticking more or less to the face of the belt, so that it falls down during the return and very quickly fills the foundation below the return belt. This

is not so marked with a steel belt as with an indiarubber one, but the large size of pulleys required for a steel belt is a difficulty. As very large foundations cannot be provided cheaply underground, belts are not recommended. The return of the sand is better made by a reciprocating conveyor. These reciprocating conveyors are rather noisy and shaky and could not be very well used above ground on trusses of a vibrating building, but the noise and the vibration are of no consequence for underground use.

However, the underground work must be reduced to the minimum in any continuous foundries, as it is always very difficult to inspect and keep in good condition; although reciprocating conveyors can be reliable, it is better, if it is possible, to dispense with their use. With pressure or jolt ramming machines, very little sand falls down, and it is cheaper and safer to shovel it, if necessary, than to use a special conveyor. Such, however, is not the case with the sand-slinger machines, because the return is practically 50 per cent. of the sand, and thus this is to be considered as increasing considerably the capacity of all transporting devices and the cost of foundations.

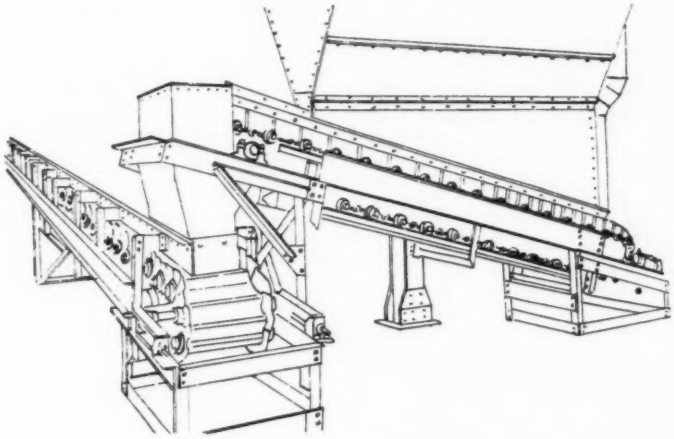

Fig. 18.—A Method of Feeding the Largest Sizes of Boxes.

Mould Conveyors.

Though the chief purpose of this Paper refers to continuous-sand plants, a word can be said of moulding conveyors. The first mould conveyors were composed of trucks on wheels running on rails, either pushed by hand or by mechanical devices. The trouble with these arrangements was that, with the sand in the foundry, it was very difficult to keep the rails clean; there was always some dirt or iron there, blocking wheels occasionally, if there were mechanical devices, or setting up a flat on their rim.

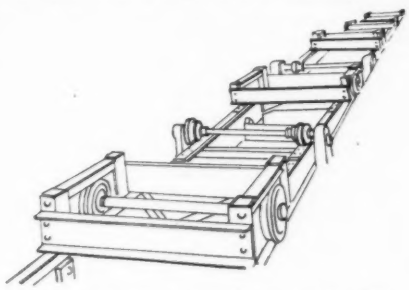

Fig. 19.—Mould Conveyor of the Plate Variety.

After various attempts, this type has been discontinued, and moulds have been put on plates, sliding on rails, and this was of general use in U.S.A. until recently. On account, however, of the high power taken by such conveyors, it has been tried recently to come back to the first idea, by making some arrangement to protect rails. However, this is very difficult, and it seems that it is partly now abandoned.

The author has thought that some advantages could be had by replacing the fixed rollers by lines of rollers on which the plates can move. Horizontal guide rollers are fixed to these plates and move between lateral guides, as shown in Fig. 19. The plates are linked to each other, making a complete circuit; it is only necessary to connect a certain amount of rollers together and to pull the plates some way or another to make the entire circuit move: the power thus required is very small. The simplicity and the facility of upkeep are apparent.

Continuous plants have come to stay. For a certain time the drawbacks and difficulties encountered in these plants were such that foundrymen hesitated to instal them. Much experience has come, and now they really can be installed and worked with safety, and, moreover, with great economy when they are properly designed and built.

DISCUSSION.

The President (Mr. Roy Stubbs) inquired whether the cost of the sand-handling machine described by the author would be prohibitive for a small foundry. It appeared to him that unless mass production was intended, and continuous work, on a large scale, provided, the expense of the installation was hardly worth while.

Mr. Ronceray replied that a sand-rubbing machine could be made for the production of five tons an hour, and a number were already installed in jobbing foundries. It provided a continuous and abundant supply of good sand, and saved a great deal of labour, because it was not necessary always to have a man in attendance. The cost was quite moderate. Asked whether the machine was used for backing sand only, or facing sand as well, he pointed out that in a continuous foundry only one quality of sand was used. He had heard it asserted that the English sand was useless, but it would be interesting to the members of the Institute to know that at one foundry where the machine was in operation some of the most beautiful castings he had ever seen had been produced with English sand. In a continuous-casting foundry, facing sand and backing sand were practically the same.

Portable Aerators.

Mr. W. Jolley remarked that one reason why there would be little discussion arising out of the lecture would be that the sand plants they had had explained to them were something that they often read about but seldom saw, especially in Lancashire, and it was always said that the maintenance was heavy. Mr. Ronceray would do them a favour if he would give some idea of the cost of maintenance in connection with these sand-handling machines. He agreed that what was described as sand "conditioning" was advantageous, and there was not the slightest doubt but that a better casting was produced if the sand was conditioned, even to a small extent, than if rough sand, just mixed with a shovel, was used. He was surprised the author had not told them something about the portable aerator, because at the foundry he was superintending they had certainly found that the portable machines gave excellent results and were a distinct advantage.

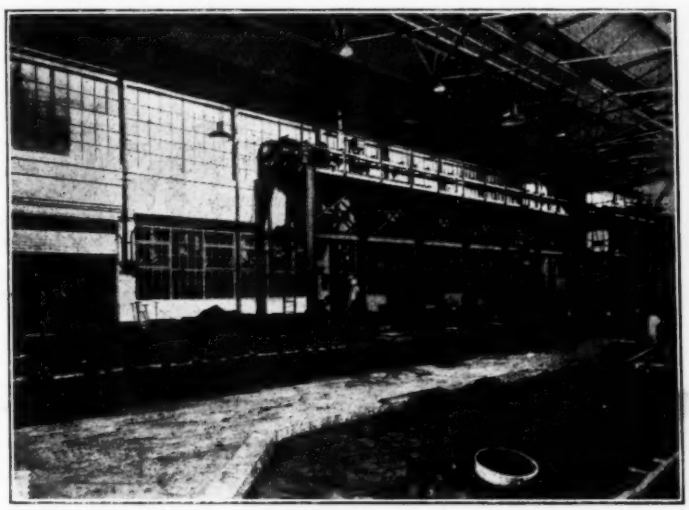

Fig. 20.—The General Appearance of a Modern Mechanised Foundry.

Maintenance Costs.

Mr. Ronceray replied that it was difficult to give maintenance figures for the small plants referred to by the last speaker because, so far as he knew, none had been incurred. The machines did not seem to wear out. For instance, he had one in mind which had been in operation twelve or fourteen months, and there were still the marks of the blacking brush on it. For the continuous machines the material was very carefully selected, and all the wearing parts were made of hard steel. There were many machines for mixing sand, but the feature of the one he had been

(*Concluded on page* 138.)

Trade Talk.

Messrs. William Gray & Company, Limited, West Hartlepool, have secured an order from a London firm for a cargo steamer of 9,000 tons deadweight.

The Lancashire Dynamo Company, Limited, of Trafford Park, Manchester, has received a large repeat order from Athens for a number of "Maxtorq" motors.

The Great Western Railway have contracted with the Nor-Rust Liquid Lead Company, Limited, for the coating of approximately 200,000 ft. of steel with "Nust" at the docks at Fowey.

Lithgows, Limited, Port Glasgow, have received an order for a fruit-carrying vessel of 8,000 tons gross from Kaye, Son & Company, Limited, managing agents for the Jamaica Direct Fruit Company.

The North Lonsdale Iron & Steel Company, Limited, yesterday closed down their ironworks at Ulverston, owing to shortage of orders for pig-iron and the fact that heavy stocks of iron are held.

Messrs. Cox & Danks, Limited, who have been so successful in raising the ex-German fleet at Scapa Flow, were recently requested by the Admiralty to give their assistance in connection with the salvage of H.M.S. "Emperor of India," sunk off Bognor Regis. This battleship was successfully refloated on August 14 and subsequently towed by Admiralty tugs into Portsmouth Dockyard.

The English Steel Corporation, Limited, recently despatched from its Grimesthorpe Foundry, Sheffield, one of seven castings it is making for a large forging press being manufactured by Messrs. Davy Bros., Limited, Sheffield, to the order of the Russian Government. The lightest of the castings weighs 22¼ tons, and the heaviest—that removed recently—is 69½ tons in weight.

An unsual incident occurred at the foundry of the Grahamston Iron Company, Limited, Falkirk, during a storm on August 17. A flash of lightning is believed to have caused the ignition of a pailful of paint mixed with naphtha which was being carried by a girl. The contents flared up, and the girl dropped the pail, but not before her hands were badly burnt. The flames spread to the woodwork of an adjoining shed and then to the roof, which was severely damaged.

Rumours of a general import restriction in Uruguay affecting British exports are officially denied by the Uruguayan Legation in London. It is stated that in order to increase the value of the country's depreciated exchange, the Uruguayan Government has proposed a law restricting imports into Uruguay, but exports of foreign countries buying Uruguayan products are not included. Consequently the present conditions for the allowance of British goods in Uruguay will not be modified.

Alexander Stephens & Sons, Limited, Linthouse, Glasgow, have launched the twin-screw turbine steamer "Carthage," for the P. and O. Company. The vessel has a gross tonnage of 14,000 and a speed of 19½ knots, and is intended for service to China and the Far East. Henry Robb, Limited, Leith, have launched the "Lasonia," a passenger and cargo vessel of 600 tons deadweight, built to the order of the Falkland Islands Company Limited, for service between the Falkland Islands and the seaports on the south-easterly coast of South America.

The "British Exhibitor," the exhibition ship which Lord Auckland and his associates are to send to South America with a representative cargo of British goods in November, sailed from Liverpool for London on Saturday, August 22. She has now been completely transformed from a cargo and passenger liner into a floating exhibition, and some of the exhibits have already been installed. During her two months' stay in the Thames the "British Exhibitor" will be berthed in the Victoria Dock. There she will be on view to visitors prior to her departure on November 1. Her first port of call is New Orleans.

Continuing their policy of concentration of production, the board of Messrs. Vickers-Armstrongs, Limited, have decided to transfer from their Erith works the manufacture of the products at present being made there. The manufacture of the heavier products of these works has already been transferred to the company's works at Newcastle and Barrow-in-Furness, and the company now intend to concentrate the lighter products in their Crayford and Dartford works. Owing to the proximity of the three works the company do not consider that there will, in consequence of this rearrangement, be any serious disturbance of employment in the district.

Personal.

Mr. Peter Beaton has been appointed general manager of Messrs. R. Y. Pickering & Company, Limited, railway rolling-stock builders, Wishaw.

Mr. T. Jackson, manager of the rolling mills of Messrs. Arthur Lee & Sons, Limited, Crown Works, Sheffield, has severed his connection with the company.

Mr. James Affleck, B.Sc., who has been foundry manager of G. & J. Weir, Limited, Holm Foundry, Cathcart, for many years, has resigned owing to ill-health. He has been succeeded by Mr. N. McNamus, M.B.E., who has been in charge of the Argus Foundry, Thornliebank, since its inception.

The whole of the foundry industry, especially those connected with the supply of plant, will learn with pleasure that this month Mr. & Mrs. F. W. Bridges are celebrating their golden wedding. Many of course will have the chance of personally expressing their good wishes when they visit the forthcoming Shipbuilding & Engineering Exhibition to be held at Olympia next month.

Mr. A. M. Cleverley, B.Sc., who has been in the employment of the Falkirk Iron Company, Limited, as enamelling-shop chemist for the last ten years, has resigned in order to take up an appointment with the Rustless Iron Company, Limited, Keighley. Mr. Cleverley has been local secretary of the Falkirk Section of the Institute of British Foundrymen for some years.

Sir Holberry Mensforth has resigned from the board of directors of Messrs. Dorman, Long & Company, Limited, of which he has been a member since the absorption of Messrs. Bolckow, Vaughan & Company, Limited, in 1929. Sir Holberry, who is a native of Bradford, has held many responsible positions in the industrial world, and about a year ago became chairman of the English Electric Company, Limited. For many years he was associated with the British Westinghouse Electric & Manufacturing Company (now the Metropolitan-Vickers Electrical Company, Limited), of Trafford Park, being general manager of works. He resigned in 1920 to take up the position of Director-General of Factories at the War Office. In 1926 he was appointed managing director of Messrs. Bolckow, Vaughan & Company, and undertook the task of reorganising the firm. Following the amalgamation with Messrs. Dorman, Long & Company he became a director of that firm.

Wills.

Lewis, J., chairman of George Freeman, Limited, iron merchants £26,570

Holt, John Oakes, of Moseley and Birmingham, metal merchant £6,464

Morris, Herbert, chairman of Messrs. Herbert Morris, Limited, Loughborough £102,843

Warden, F. H., of Edgbaston, head of Messrs. F. H. Warden, Limited, iron and steel merchants £7,412

Wicksteed, Charles, of Kettering, founder and managing director of Messrs. Charles Wicksteed & Company, Limited, machine-tool manufacturers £21,761

Wilson, Robert Theodore, of Marton-in-Cleveland, Yorks, ironmaster, for many years a partner of Wilson, Pease & Company, now merged in Messrs. Pease & Partners, Limited... £28,572

Obituary.

Mr. Magnus Henderson, cashier to the Falkirk Iron Company, Limited, died in the Falkirk Infirmary on August 15. He had served with the company for over thirty years.

Mr. Henry Wood, the senior J.P. for Bolton, whose death occurred recently, was the head of Messrs. J. & D. Wood, of the Victoria Foundry, Bolton, until the firm closed down in 1912. He was 71 years of age.

Mr. Duncan Simpson died at his home in Falkirk on August 16. He had been for over fifty years in the service of the Falkirk Iron Company, Limited, and was one of the "gold-watch" employees. His period of service dated back to the days when contracting for the company was carried out by hirers in the district, and when the company took over their own contracting work, Mr. Simpson was placed in charge of the department and at the time of his death was labour foreman.

New Companies.

J. N. Henderson, Limited, 5, Leigh Park Road, Leigh-on-Sea.—Capital £4,000. Ironfounders, etc. Director: J. N. Henderson.

S. X. Foundry Company, Limited, 13, Grosvenor Rise East, Beulah Road, Walthamstow.—Capital £250. Directors: R. H. Fuller, E. Williams and J. G. Dyer.

Staveleys, Limited.—Capital £4,000. Engineers, etc. Directors: R. Greenhalgh, Breeze Hill, Atherton, N. W. Greenhalgh, R. Morris, E. O. Staveley and J. Stilling.

Redshaw & Company, Limited, Lomax Street, Rochdale.—Capital, £1,500 in £1 shares. Ironfounders, mechanical engineers, etc. Directors: A. Redshaw, Miss E. Redshaw, J. L. Fielding and A. Hankinson.

Automatic Sand Plants.

(*Concluded from page* 137.)

describing was that there was a rubbing operation. It was not generally known that the consumption of sand, when it was rubbed, was three or four times less than when it was merely mixed, whatever the type of the mixer was. One French firm had a machine on trial and in the first week they saved 15 tons of new sand, and the economy in that direction soon recouped them for the outlay.

Mr. E. Longden said that the author had conveyed the impression that the belt conveyor was not quite so serviceable as the pan or scraper conveyor for particular sections of the continuous-casting plant. For many years, probably thirty, the belt had been in operation for continuous-casting plants. In America, in particular, the belt had been used, and it occurred to him that the complaint made against it could be levelled with greater force against the scraper conveyor. With the latter there was more friction on the plates and pan or trough. With the belt, the sand was simply lying on and little or no friction resulted. He saw many plants in the course of his recent visit to America, and there was very little trouble with the belt conveyor. The point made by Mr. Ronceray with regard to the sand sticking to the belt, or falling on to the foundations of the equipment was easily avoided by the provision of suitable scraper mechanism. He would like to know how the new sand was fed into the rubbing machine, and how much new sand was added for making facing sand when the machine was used for facing sand and not backing sand.

Sand Packing.

Mr. Ronceray remarked that the objection to the belt was the falling down of the sand in the individual sand bins, and though they had tried brushing to take it off, some always remained. It was very difficult, if not impossible, to reply to the question as to the proportion of new sand to be used to old. It depended on two things—how deeply the old sand was burnt and the weight of the castings to be made. The nature of the metal, too, had some bearing on the matter. The effect of pouring lead was not the same as when pouring steel. A proportion of 50 per cent. of new sand was, perhaps, necessary for steel, although in other cases only 1 per cent. was required.

The author was accorded a cordial vote of thanks on the proposition of Mr. W. Jolley, and seconded by Mr. J. S. G. Primrose. In reply, Mr. Ronceray made a brief reference to an International Conference to be held in Paris in September of next year.

Hints for Commercial Visitors to the Netherlands East Indies.—The Department of Overseas Trade (35, Old Queen Street, Westminster, S.W.1) has published a pamphlet bearing this title prepared from information supplied by the British Commercial Agent at Batavia. United Kingdom firms may obtain copies on application to the Department (quoting Ref. No. C. 3,594).

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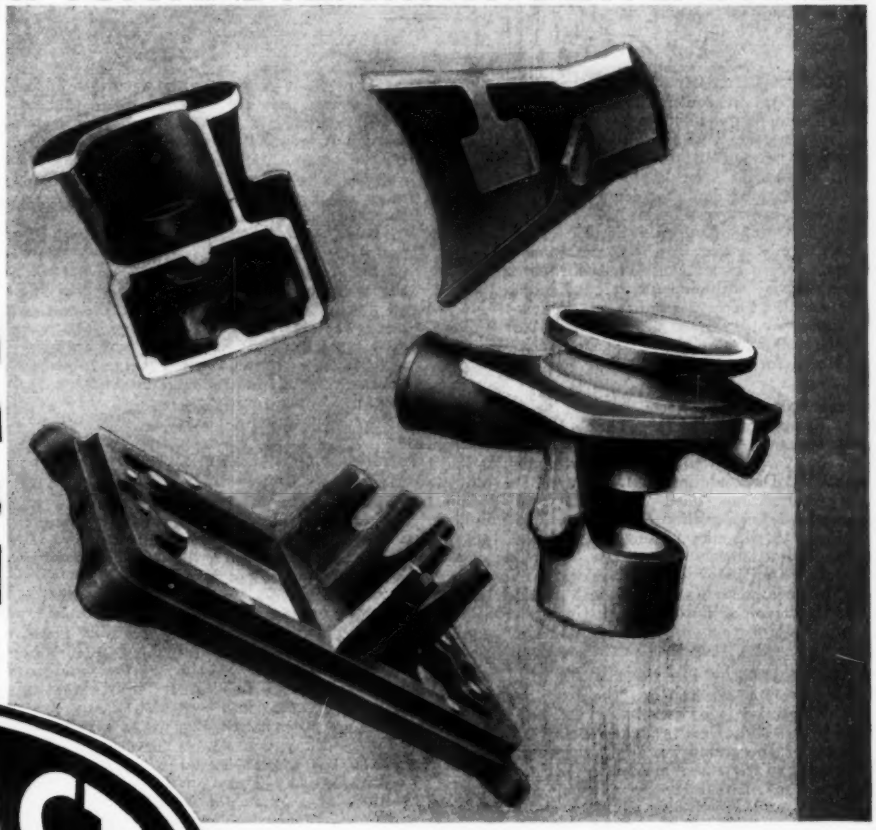

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Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—The steady decline in pig-iron consumption continues, and there is no sign of any immediate improvement. Last week being holiday week on Tees-side, all local deliveries were completely suspended. The steady increase in the stocks of unsold iron has been countered by the expensive step of damping down still more furnaces, until there are now only 19 working on the North-East Coast out of a total of 88. The Cleveland makers firmly maintain their minimum price-level, in spite of undercutting in their home market, where a considerable quantity of Midlands iron is being sold. Prices remain as follow:—No. 1 Cleveland foundry iron, 61s. per ton; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; and No. 4 forge, 57s. per ton.

The East Coast hematite market is still in a depressed condition. Local makers' prices compare very favourably with those quoted by the West Coast furnaces, yet they find home industrial consumption very limited, and export business hard to obtain. Demands made by buyers are only to satisfy immediate needs, and forward business is practically non-existent. The nominal quotation for East Coast mixed numbers remains at 61s. per ton, but lower prices are being negotiated privately. On the North-West Coast there is very little business moving. The local steel trade remains inactive, and there is little probability of any immediate revival. Bessemer mixed numbers are maintained at 66s. per ton at works.

LANCASHIRE.—Last month's slight increase in the demand for pig-iron for the textile machinery trade has proved to be merely a spurt, and consumption in that branch has fallen away again. The majority of the foundries are under-employed, and are buying little raw material. For delivery to users in the Manchester price zone, Staffordshire, Derbyshire and North-East Coast brands of No. 3 iron remain at 67s. per ton, with Northamptonshire foundry iron at 65s. 6d., Derbyshire forge at 62s., Scottish No. 3 at 87s. to 87s. 6d., and West Coast hematite iron at about 80s. 6d. per ton.

MIDLANDS.—There is no increase in the local consumption of pig-iron, and what little business is passing is only for small parcels for immediate requirements, the ironfounders, apparently, having no faith in the present price level. For delivery to Birmingham and Black Country stations, the furnaces continue to quote 62s. 6d. for Northants No. 3 and 66s. for Derbyshire, North Staffordshire and Lincolnshire No. 3.

SCOTLAND.—The demand for pig-iron remains very limited, and there is still only one blast furnace working in the country. The ironfounders are short of work, and there are no prospects of any early improvement in their consumption of raw material. Makers continue to quote 71s. per ton for No. 3 foundry, f.o.t. furnaces, with a minimum of 2s. 6d. per ton extra for No. 1. Continental No. 3 is obtainable at 53s., f.o.t. Grangemouth, with Middlesbrough No. 3 at about 5s. more.

Finished Iron.

The market remains almost lifeless and the majority of the mills can only work spasmodically. Competition is keen for the few orders available, and quotations vary considerably. The price of Staffordshire crown iron ranges from £9 5s. to £10, whilst nut and bolt iron is quoted at from £8 5s. to £8 10s., the bulk of the latter grade of iron, however, being supplied from the Continent at much lower figures. The price of Staffordshire marked bars is maintained at £12, makers hoping that the demand will shortly improve.

Steel.

The position of the finished-steel trade remains unsatisfactory, although it is hoped that the slight revival in the shipbuilding industry now taking place will shortly have some beneficial effect. Continental competition has become more intensified than ever. The market for semis is very irregular, and the demand limited. Continental prices are giving way, under the strain of poor trade, but business remains scarce.

Scrap.

There were practically no dealings in the Cleveland market last week, the works in that area being closed, owing to the holidays. Prices, therefore, were only nominal, ordinary heavy cast iron being quoted at 40s. per ton, and good machinery quality at 42s. The market has not yet recovered any large measure of activity. The Midlands market remains stagnant, heavy machinery scrap being offered at 47s. 6d., and light cast-iron scrap at 37s. 6d., per ton delivered. The South Wales market continues to be quiet, prices being low in accordance with the poor demand. The Scottish market is still in an unsatisfactory position, prices in general remaining low. Machinery cast-iron scrap, in pieces suitable for foundries, has, however, tended to stiffen a little, the present price being about 47s. 6d. Ordinary metal, to the same specification, is quoted at 41s. 3d. per ton.

Metals.

Copper.—The efforts to secure a general suspension of production in the copper mines of the United States and elsewhere have failed, the cost of such a step being apparently too strong a deterrent. The month of July saw a large increase in the stocks of unsold copper in the U.S.A., and a like surplus seems to be assured for the current month. Prices, however, have not declined to any great extent, as producers are inclined to hold on, in hope of an early improvement in the market, and consumers find business so difficult to secure that they are chary of entering into contracts of any size.

Closing quotations:—

Cash.—Thursday, £32 5s. to £32 6s. 3d.; Friday, £32 7s. 6d. to £32 8s. 9d.; Monday, £32 12s. 6d. to £32 13s. 9d.; Tuesday, £32 10s. to £32 11s. 3d.; Wednesday, £32 8s. 9d. to £32 10s.

Three Months.—Thursday, £33 2s. 6d. to £33 3s. 9d.; Friday, £33 5s. to £33 6s. 3d.; Monday, £33 10s. to £33 11s. 3d.; Tuesday, £33 6s. 3d. to £33 7s. 6d.; Wednesday, £33 6s. 3d. to £33 7s. 6d.

Tin.—There seems to be no hope of a general improvement in the demand. All the tinplate works, in South Wales, on the Continent, and in America, are suffering from lack of business, and their consumption of raw material has greatly decreased. However, the future of tin seems to lie, not in an increased consumption, but in a restriction of supply. The conference at The Hague has been successful in reducing the production quota for Malayan mines by some 3,700 tons per annum. International co-operation and restriction seems to be the solution to the problem.

Official closing prices:—

Cash.—Thursday, £115 2s. 6d. to £115 5s.; Friday, £115 12s. 6d. to £115 17s. 6d.; Monday, £114 10s. to £114 12s. 6d.; Tuesday, £116 17s. 6d. to £117; Wednesday, £119 10s. to £119 12s. 6d.

Three Months.—Thursday, £117 12s. 6d. to £117 15s.; Friday, £118 5s. to £118 7s. 6d.; Monday, £117 to £117 2s. 6d.; Tuesday, £119 10s. to £119 12s. 6d.; Wednesday, £122 to £122 5s.

Spelter.—A reduction in output was finally ratified last week at the Paris meeting of the international cartel. It is hoped that a restricted production will successfully balance the decreased demand. Conditions in the spelter market in America, and at home, where the position of the galvanised-sheet trade remains unsatisfactory, are very dull.

Ordinary.—Thursday, £11 18s. 9d.; Friday, £11 13s. 9d.; Monday, £11 8s. 9d.; Tuesday, £11 11s. 3d.; Wednesday, £11 15s.

Lead.—Stocks in this country remain large, but prices are firmly maintained. The statistical position in the U.S.A. has improved somewhat, production having been considerably restricted. The outlook in the home market remains very obscure.

The week's prices have been:—

Soft Foreign (Prompt).—Thursday, £11 16s. 3d.; Friday, £12; Monday, £11 18s. 9d.; Tuesday, £11 18s. 9d.; Wednesday, £12 3s. 9d.

As magnesium does not alloy with iron or steel, it can be melted in iron and steel pots without a protective wash.

Students' Corner.

Q.—What is implied by iron foundry welding or "burning-on"?

A.—"Burning-on" is a foundry term for uniting parts of a casting by fusion, the fusing agent and filling medium being molten metal. The term needs some further defining. For instance, there are examples of burning-in and burning-on; in other words, and perhaps better stated as, welding-in and welding-on—in some respects two quite different things.

Firstly, to burn-in or weld-in (when practical), by means of molten metal, is to fuse together two broken parts of a casting, a crack, a cold-lap, a hole or a rupture of any kind. Secondly, to burn-on or weld-on is to add to an existing casting in a previously-prepared mould, the part required, such as a part of a propeller blade, the broken part having been lost, or burning-on a new roll neck, the mould for which is made from a pattern. Cast iron being a complex alloy, composed of a combination of metals and non-metals, with varying fusing points, specific gravities, etc., it is more difficult to weld than steel or many non-ferrous metals, including brasses, bronzes and aluminium, due to chilling and erratic contraction and expansion.

Q.—What are the necessary precautions to ensure a good weld or burn?

A.—Though there are simple and complicated burns or welds, yet in either case the general precautions to be taken are:—(1) That the parts to be welded are well cleaned and preferably roughened by a cold flat or diamond-point chisel. With a rough surface the burning-on, or melting-in, metal starts fusion quicker than with a smooth surface; (2) That pre-heating to redness, if possible, in either case is desirable, not only to start the weld quicker, but to minimise the ever-present risk of cracking due to expansions and contractions; (3) That the welding metal in the ladle should be in a highly liquefied and superheated condition. It is also desirable in many cases, especially when machining follows the weld, that the welding metal be softer and tougher if possible than the original casting, and (4) That the weld, if a large one, when completed should be covered by fine dry sand, and when solidified, an abundance of hot scrap from the run-off metal placed around and on the welded part; this ensures slow cooling and softness, also with large-area complicated welds it will minimise contraction troubles.

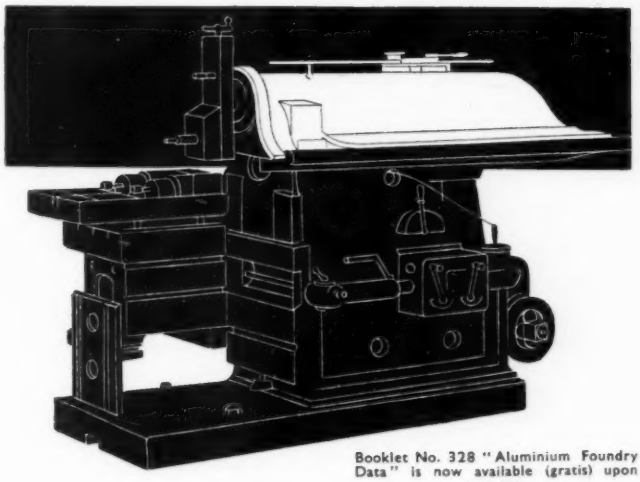
Q.—What is the difference between a simple and a complicated weld?

A.—To explain this difference in words only is not easy. Examples of simple burns may include the welding of a new lug on an old moulding box, or adding a new piece on to an old or new broken casting, such as a piece on to a flange, a propeller blade, or a roll neck. Although, in any of these cases, the general precautions must be observed, no expansion or contraction troubles are likely to arise during pre-heating or cooling.

Examples of complicated welds include welding-up long cracks or cold-laps in thin, hollow, circular castings, large-area holes or porous parts surrounded by walls of metal. These involve risks, even when all general precautions are taken, such as expansion cracks when pre-heating, or during the actual operation of burning or welding, as well as contraction cracks when cooling. Such is a brief description of the difference between a simple and a complicated weld.

(To be continued.)

SURPLUS WEIGHT AXED



Booklet No. 328 "Aluminium Foundry Data" is now available (gratis) upon request.

If not axed, surplus weight would clutter and cloy the finest machine. An extra twenty lbs. here, fifteen there, the total swelled in dozens of parts—surplus weight soon creeps into a design all unsuspected. There is no need for it. Released from surplus weight, machinery rises to greater production capacities, possesses a bigger reserve of power for emergencies and lends itself better to control. That states precisely the prime case for light aluminium alloys in machine construction. The shaper head is one opening for aluminium. Here, as in many another part, deadweight squanders energy; aluminium saves it.

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WEATHER RESISTING STEEL
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ALL SIZES
ALL SHAPES

CAST IRON FLANGED PIPES
2 in.—12 in. & CONNECTIONS. to 24 in. dia.

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WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	32	8	9
Three months	33	6	3
Electrolytic	35	10	0
Tough	32	15	0
Best selected	33	5	0
Sheets	64	0	0
India	44	15	0
Wire bars	37	2	6
Do., September	37	2	6
Do., October	37	2	6
Ingot bars	37	2	6
H.C. wire rods	38	0	0
Off. av. cash, July	34	9	1 1/16
Do., 3 mths., July	35	3	7 3/16
Do., Sttlmnt., July	34	9	2 5/16
Do., Electro, July	37	19	4 5/16
Do., B.S., July	36	5	10
Do., wire bars, July	38	12	9 1/16
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	7½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7½d.
Wire	7½d.
Rolled metal	6½d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5½d.

TIN.

	£	s.	d.
Standard cash	119	10	0
Three months	122	0	0
English	120	10	0
Bars	122	10	0
Straits	120	10	0
Australian	120	5	0
Eastern	123	0	0
Banca	124	0	0
Off. av. cash, July	111	11	1 3/16
Do., 3 mths., July	113	9	7 15/16
Do., Sttlmt., July	111	11	3 1/16

SPELTER.

	£	s.	d.
Ordinary	11	15	0
Remelted	10	10	0
Hard	8	10	0
Electro 99.9	14	2	6
English	12	2	6
India	10	10	0
Zinc dust	19	0	0
Zinc ashes	2	15	0
Off. aver., July	12	10	9 1/16
Aver. spot, July	12	5	7 3/16

LEAD.

	£	s.	d.
Soft foreign ppt.	12	3	9
English	13	10	0
Off. average, July	12	16	3 1/16
Average spot, July	12	14	7 3/16

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	20	0	0
Do., V.M. ex-whf.	19	5	0
Rods	22	0	0
Boiler plates	14	12	6
Battery plates	16	5	0

ANTIMONY.

	£	s.	d.
Special brand, Eng.	34	0	0
Chinese	22	0	0
Crude	21	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	16	15	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	7	6
45/50%	10	7	6
75%	15	2	6
Ferro-vanadium—			
35/50%	12/8 lb Va.		
Ferro-molybdenum—			
70/75% c. free	4/2 lb. Mo.		
Ferro-titanium—			
23/25% carbon-free	9½d. lb.		
Ferro-phosphorus, 20/25%	£15	10	0
Ferro-tungsten—			
80/85%	1/8½ lb.		
Tungsten metal powder—			
98/99%	1/11½ lb.		
Ferro-chrome—			
2/4% car.	£27	10	0
4/6% car.	£21	2	6
6/8% car.	£20	10	0
8/10% car.	£19	15	0
Ferro-chrome—			
Max. 2% car.	£29	10	0
Max. 1% car.	£33	12	6
Max. 0.70% car.	£35	10	0
70% carbon-free	9½d. lb.		
Nickel—99%	£170 0 0 to £175 0 0		
Ferro-cobalt	8/9 lb.		
Aluminium 98/99%	£85	0	0
Metallic chromium—			
96/98%	2/7 lb.		
Ferro-manganese (net)—			
76/80% loose	£10 15 0 to £11 5 0		
76/80% packed	£11 15 0 to £12 5 0		
76/80% export	(nom.) £ 9 0 0		
Metallic manganese—			
94/96% carbonless	1/3 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.	£	s.	d.
South Wales						
Heavy steel	1	18	0 to	2	0	0
Bundled steel and shrngs.	1	14	0 to	1	17	6
Mixed iron and steel	1	14	0 to	1	16	0
Heavy cast iron				2	2	6
Good machinery for foundries				2	5	0
Cleveland—						
Heavy steel				1	17	6
Steel turnings				1	5	0
Cast-iron borings				1	2	0
Heavy forge				2	10	0
W.I. piling scrap				2	2	6
Cast-iron scrap	2	0	0 to	2	2	0
Midlands—						
Light cast-iron scrap				1	17	6
Heavy wrought				2	5	0
Steel turnings, f.o.r.				0	15	0
Scotland—						
Heavy steel				1	17	6
Ordinary cast iron				2	1	3
Engineers' turnings				1	5	0
Cast-iron borings				1	10	0
Wrought-iron piling				2	5	0
Heavy machinery				2	7	6

London—Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	25	0	0
Brass	18	0	0
Lead (less usual draft)	9	10	0
Tea lead	6	10	0
Zinc	5	10	0
New aluminium cuttings	52	0	0
Braziery copper	22	0	0
Gunmetal	23	0	0
Hollow pewter	76	0	0
Shaped black pewter	55	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	61/6
Hematite M/Nos.	61/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	71/6
„ d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands—	
Staffs common*	—
„ No. 4 forge*	61/-
„ No. 3 fdry.*	66/-
Shrops basic	—
„ Cold blast, ord.	—
„ „ roll iron	—
Northants forge*	57/6
„ fdry. No. 3*	62/6
„ fdry. No. 1*	65/6
Derbyshire forge*	61/-
„ fdry. No. 3*	66/-
„ fdry. No. 1*	69/-
„ basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	73/6
„ No. 3	71/-
Hem. M/Nos. d/d	70/-
Sheffield (d/d district)—	
Derby forge	58/6
„ fdry. No. 3	63/6
Lincs forge	—
„ fdry. No. 3	63/6
E.C. hematite	75/6
W.C. hematite	81/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
„ fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	87/- to 87/6
Clyde, No. 3	87/- to 87/6
Monkland, No. 3	87/- to 87/6
Summerlee, No. 3	87/- to 87/6
Eglinton, No. 3	87/- to 87/6
Gartsherrie, No. 3	87/- to 87/6
Shotts, No. 3	87/- to 87/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)	9	15	0 to	10	5	0
Nut and bolt iron	8	5	0 to	8	10	0
Hoops	10	10	0 to	12	0	0
Marked bars (Staffs) f.o.t.				12	0	0
Gas strip	10	10	0 to	12	0	0
Bolts and nuts, ¾ in. × 4 in.				12	5	0
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	9	0	0 to	9	15	0
Chequer plts.				10	7	6
Angles				8	7	6
Tees				9	7	6
Joists				8	15	0
Rounds and squares, 3 in. to 5½ in.				9	7	6
Rounds under 3 in. to ¾ in. (Untested)	6	12	6 & up.			
Flats—8 in. wide and over				8	12	6
„ under 8 in. and over 5 in.				8	17	6
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	0	0
Hoops (Staffs)				9	5	0
Black sheets, 24g.	7	15	0 to	8	5	0
Galv.cor.shts.24g.	8	15	0 to	9	5	0
Galv. flat sheets	9	5	0 to	9	15	0
Galv. fencing wire, 8g. plain				12	0	0
Billets, soft	4	17	6 to	5	5	0
Billets, hard				6	12	6
Sheet bars	4	12	6 to	4	17	6
Tin bars				4	12	6

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11¾d.
Wire	11¾d.
Rods	11½d.
Tubes	1/6d.
Castings	11¾d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
3/- to 10 g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	16.76
No. 2 foundry, Valley	17.00
No. 2 foundry, Birm.	12.00
Basic	17.26
Bessemer	18.76
Malleable	18.76
Grey forge	18.26
Ferro-mang. 80%	85.00
O.-h. rails, h'y, at mill	43.00
Billets	29.00
Sheet bars	29.00
Wire rods	35.00
	Cents.
Iron bars, Phila.	2.09
Steel bars	1.60
Tank plates	1.65
Beams, etc.	1.65
Skelp, grooved steel	1.60
Skelp, sheared steel	1.65
Steel hoops	1.80
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	2.90
Wire nails	1.90
Plain wire	2.20
Barbed wire, galv.	2.55
Tinplates, 100-lb. box	$5.00

COKE (at ovens).

Welsh foundry	22/6 to 25/-
„ furnace	14/- to 15/-
Durham and Northumberland—	
„ foundry	13/- to 14/-
„ furnace	13/-
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	13/1½ to	13/4½
„	28×20 „		26/6
„	20×10 „		19/1½
„	18¾×14 „		14/-
C.W.	20×14 „		12/9
„	28×20 „		25/6
„	20×10 „		18/10½
„	18¾×14 „		14/-
Terneplates	28×20		26/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

	£	s.	d.	£	s.	d.
Pig-iron	6	0	0 to	7	0	0
Bars, hammered, basis	16	10	0 to	17	0	0
Bars and nail-rods, rolled, basis	15	17	6 to	16	5	0
Blooms	10	0	0 to	12	0	0
Keg steel	32	0	0 to	33	0	0
Faggot steel	18	0	0 to	23	0	0
Bars and rods dead soft, st'l	10	0	0 to	12	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Current Discounts.

	Tubes.	*Fittings.*
Gas	62½%	57½%
Water ..	58½%	52½%
Steam ..	55%	47½%

W.I. 12½% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.	
Aug.	20 ..	32	5	0	dec. 3/9
,,	21 ..	32	7	6	inc. 2/6
,,	24 ..	32	12	6	,, 5/-
,,	25 ..	32	10	0	dec. 2/6
,,	26 ..	32	8	9	,, 1/3

Electrolytic Copper.

		£	s.	d.	
Aug.	20 ..	35	10	0	No change
,,	21 ..	35	10	0	,, ,,
,,	24 ..	35	10	0	,, ,,
,,	25 ..	35	10	0	,, ,,
,,	26 ..	35	10	0	,, ,,

Standard Tin (cash).

		£	s.	d.	
Aug.	20 ..	115	2	6	inc. 25/-
,,	21 ..	115	12	6	,, 10/-
,,	24 ..	114	10	0	dec. 22/6
,,	25 ..	116	17	6	inc. 47/6
,,	26 ..	119	10	0	,, 52/6

Tin (English ingots).

		£	s.	d.	
Aug.	20 ..	116	15	0	inc. 35/-
,,	21 ..	116	15	0	No change
,,	24 ..	115	10	0	dec. 25/-
,,	25 ..	118	0	0	inc. 50/-
,,	26 ..	120	10	0	,, 50/-

Zinc Sheets (English).

		£	s.	d.	
Aug.	20 ..	20	0	0	No change
,,	21 ..	20	0	0	,, ,,
,,	24 ..	20	0	0	,, ,,
,,	25 ..	20	0	0	,, ,,
,,	26 ..	20	0	0	,, ,,

Spelter (ordinary).

		£	s.	d.	
Aug.	20 ..	11	18	9	inc. 11/3
,,	21 ..	11	13	9	dec. 5/-
,,	24 ..	11	8	9	,, 5/-
,,	25 ..	11	11	3	inc. 2/6
,,	26 ..	11	15	0	,, 3/9

Lead (English).

		£	s.	d.	
Aug.	20 ..	13	5	0	inc. 5/-
,,	21 ..	13	10	0	,, 5/-
,,	24 ..	13	10	0	No change
,,	25 ..	13	10	0	,, ,,
,,	26 ..	13	10	0	,, ,,

AVERAGE MONTHLY PRICES OF WEST COAST HEMATITE MIXED NUMBERS DELIVERED SHEFFIELD.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1868	44 4	42 3	42 1½	42 0	41 2½	42 1½	42 6½	44 0	45 8½	44 6	44 6	45 3½	43 4
1889	44 4	45 2	47 3½	48 9½	48 6½	48 7½	50 1½	53 11	55 3	63 6	73 10	73 2	54 4½
1890	76 1½	65 1	63 3	55 1	53 9½	50 11	52 3½	56 4	58 0	58 2	57 5	54 4½	58 5
1891	52 9	50 10	48 11	47 9½	51 5	50 6	50 10	48 4	50 1	49 1½	48 3½	47 8	49 8½
1892	47 4	45 6	46 4½	47 8	49 5	50 4½	49 7½	49 10½	49 10½	48 8½	46 10	46 1½	48 2½
1893	46 0½	45 8	45 11	45 7	44 11	44 9½	44 10	45 3	45 0	44 6	44 7	45 8	45 3
1894	45 3	45 3	45 1½	45 1	43 11	43 11	43 9½	44 2	44 7½	43 7	43 5	43 3	44 3½
1895	42 8	42 5½	42 6	42 10	43 10	43 7½	44 10	45 11	49 11	48 9	47 7½	47 7½	45 2½
1896	47 0	48 9	48 9	48 2½	47 3	47 3	46 10	46 10	47 2	48 5	50 7	50 6	48 1½
1897	51 2	49 10	48 5	47 4	47 9½	48 6	47 0	47 3	47 3	47 0	48 3½	47 11	48 2
1898	48 9	48 10	49 4	49 8½	50 10	50 3½	51 0	52 5	53 11	55 8	57 3	56 10	52 1½
1899	59 1	59 9	57 7	59 6	64 7	70 10½	76 7½	72 2	74 3	75 0	78 1½	73 3	68 5
1900	75 3½	76 10	79 10	84 6	81 4	79 1½	83 4	81 5	79 11	76 10	77 8½	68 4	78 8
1901	60 2	59 0	57 9½	57 6½	57 8	57 4½	57 8	61 0	60 0½	59 9	58 7½	56 7	58 7½
1902	56 1	57 9½	59 3½	59 9	59 10½	60 0	60 0	60 8½	61 5	61 2	59 3	59 0	59 6
1903	58 5	58 8	61 1	59 5	57 10	57 3	56 7	56 3	55 9	54 8	52 4	52 4	56 8½
1904	52 8½	53 1	53 7	54 9	54 2	53 2½	52 9	52 5	52 2½	52 7	53 1	55 11½	53 5½
1905	57 9½	56 9	58 1	58 2	56 4	55 8	55 5½	56 7	61 0	68 9	69 9	70 11½	60 5½
1906	70 4½	65 2½	63 4½	63 9	64 5	64 6	64 1	66 2½	67 3	69 4½	72 4½	78 8½	67 5
1907	77 9	72 11	71 10	73 9	79 9½	76 9	77 9	78 4	75 11	72 9½	68 6	66 7	74 4
1908	62 7	59 1	61 6½	61 6½	61 4	59 1	57 9½	56 11	60 2	59 2	58 5½	57 7	59 7½
1909	51 4	56 5	55 3	56 1	56 4	57 0	56 8	58 0	61 0	61 1½	60 7½	61 4	58 1½
1910	64 0½	64 3½	66 10½	67 6½	66 2½	65 4	64 4½	65 6½	65 2	64 10½	64 6	65 6	65 4½
1911	66 9	66 1	64 10	63 1	62 1	62 0	61 2	62 2	62 1	61 1	61 10	64 0	63 1
1912	67 0	67 0	67 0	69 3	71 9½	72 11	75 9½	79 1½	82 2½	85 0	85 3½	86 6	75 9½
1913	86 6	86 6	86 3	85 0	83 6½	80 10½	78 1	76 10½	72 6	71 0	68 0	65 3	78 4½
1914	64 6	65 4½	65 6	64 11½	64 2½	64 0	64 0	68 11½	74 6½	71 0	65 4½	69 9½	66 10½
1915	78 9	100 6	103 1	113 6	111 9	114 0	116 3	115 2½	113 8½	121 1½	131 9½	139 6½	113 3
1916	135 0	135 0	133 4	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	129 2½
1917	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1918	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6	127 6
1919	127 6	127 6	127 6	127 6	180 6	184 3	195 4½	204 6	204 6	204 6	204 6	204 6	174 7
1920	224 9	235 0	245 0	275 0	290 0	295 0	295 0	295 0	295 0	295 0	295 0	280 0	284 11½
1921	263 4	228 4	180 0	180 0	180 0	160 0	160 0	157 6	142 0	128 6	121 0	115 6	167 9½
1922	125 0	117 6	115 0	115 0	115 0	115 0	113 1½	104 0	105 0	105 0	106 3	110 0	112 1½
1923	109 0½	116 5½	133 11½	138 3½	134 2	125 0	115 7½	111 9	110 0	110 0	113 11	115 0	119 5½
1924	115 0	115 0	114 4½	112 6	112 6	112 6	111 0	110 0	110 0	105 4½	102 6	102 6	110 3½
1925	102 6	102 6	100 0	98 6	97 6	95 1½	92 6	90 6	88 3	87 0	88 1½	88 9½	94 3½
1926	90 1½	90 0	89 8½	89 0	89 0	89 0	90 2½	91 9	94 0	97 2½	*	*	91 0
1927	95 4½	95 6	96 6	95 6	95 3	94 0	92 10½	91 6	90 6	90 6	90 6	89 6	93 1½
1928	85 0	85 3	85 5	85 0	85 3	84 9	84 0	83 9	84 0	84 0	83 1	82 6	84 4
1929	82 10½	83 6	85 0	86 9	87 0	87 0	87 3	87 2½	87 6	89 6	89 6	89 10½	86 11
1930	91 6	91 6	91 6	90 0	89 7½	88 0	87 7½	86 6	86 6	86 6	86 6	86 6	88 6½
1931	86 6	84 6	84 6	84 6	84 6	82 6	82 6	—	—	—	—	—	—

* No prices available.

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Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

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